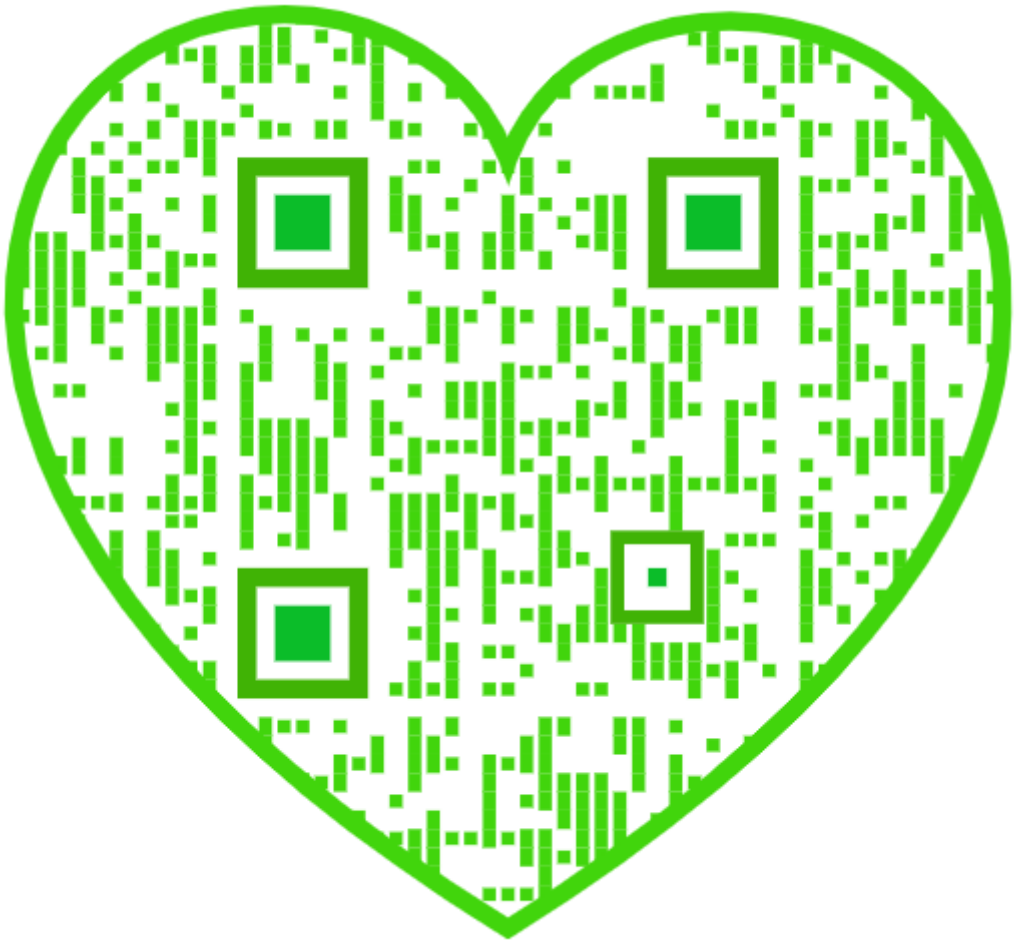
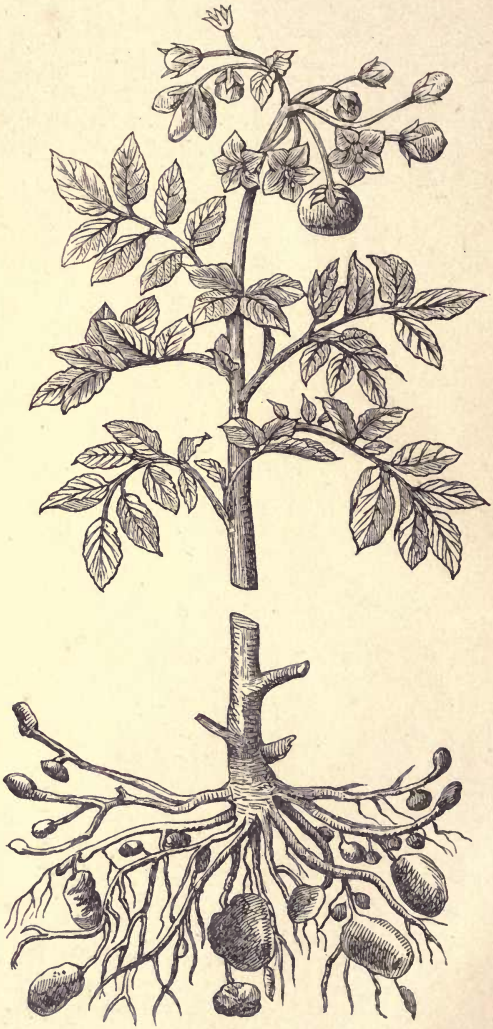
POTATOES

HOW TO GROW AND SHOW THEM

James Pink





THE WILD POTATO,
As grown by GERARD, and figured in his 'Herbal,' published 1597.

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POTATOES

HOW TO GROW AND SHOW THEM

A PRACTICAL GUIDE TO THE CULTIVATION
AND GENERAL TREATMENT OF
THE POTATO

BY

JAMES PINK

AUTHOR OF 'HOW TO GROW ONE THOUSAND POUNDS OF POTATOES FROM ONE POUND OF SEED'

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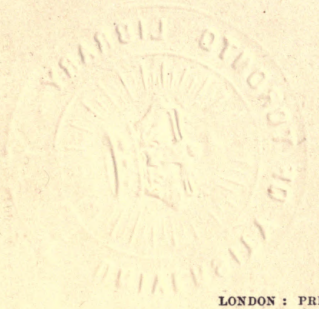

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PREFACE.

THE value of the POTATO, and the interest taken in its culture at the present day, must be my excuse for laying before the public my method of culture, which may be considered to have been fairly successful, it having obtained for me, during the last four years, the greatest number of prizes of any one exhibitor at the great International Potato Exhibitions. Many of the public who visited those exhibitions, and saw the splendid samples there shown, so superior to those they had been in the habit of growing in their own gardens, imagined that there is some secret, known only to the few, by which those samples were produced. But there is no royal road to success, the only secret being—GOOD CULTURE, the principles of which I have endeavoured to give in the following pages.

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POTATOES.

CHAPTER I.

INTRODUCTION—USES OF THE POTATO—RELATIVE VALUE AS AN ARTICLE OF FOOD—AMOUNT OF PRODUCE PER ACRE—SPECIMEN OF FIELD CULTURE.

THERE is nothing in Nature that more forcibly illustrates the truth of the adage 'necessity is the mother of invention' than the way in which man has regenerated and improved a large portion of the vegetable kingdom, and made it subservient to his wants. It matters not whether we look to the Useful or to the Ornamental department of that kingdom—at the beautiful flowers that adorn and beautify our gardens and add a charm to our daily lives, or to the more useful, the fruits and vegetables that supply our wants. In each department is the thought and skill of man apparent, as year by year new forms of beauty are added to our already large list of flowers, and new and improved varieties to our stock of fruits and vegetables.

And nowhere in the vegetable kingdom have man's labours been rewarded with such momentous results to the world at large as in the improvement wrought in

the POTATO; the Creator placing the wild plant in his hands, and leaving to his philosophical mind and energy its future development.

And right well has this been achieved; for who would recognise the splendid tubers now seen on our exhibition tables as being the progeny of a wild and apparently useless herb, whose fruit and foliage possess strong narcotic properties, and whose tubers are small, bitter, and almost unpalatable; and we are told by American travellers that in its wild state its tuber-forming properties are so small that an acre produces scarcely sufficient to sustain a score of people for one day.

It is not only as an esculent vegetable that the potato is valuable, but also for other and various purposes. Large quantities of starch are annually extracted from its tubers, which is not only used for domestic purposes in almost every household, but also in the arts and manufactures. The potato is used in medicine; its starch is sold under the name of English arrowroot; it may be converted into dextrine or British gum (which is often substituted for gum arabic); and sugar and alcohol are extracted from its tubers.

To a thickly-populated country like England, which depends to a great extent on foreign growth for the supply of its markets, the culture of the potato may become an object of even far greater importance than at present. History proverbially repeats itself, so that we have only to call to mind the distress that was prevalent in England during the early part of the present century, when our commerce suffered so severely on account of the French war, and when in the years

1808–9—the corn laws being in full force—flour rose to the enormous price of 28*s*. per bushel, and bread riots took place in several parts of the kingdom; and, as it is quite possible the day may come when England will, to a certain extent, be thrown on her own resources, we cannot help asking ourselves, if distress was so prevalent and food so scarce when the population was only half what it is at present, what would be the result now the country is so densely populated?

Therefore, should the time ever come that we should have to depend on our own productions, the potato, in all probability, would be much more largely grown than corn, for the simple reason that it is capable of producing from the same extent of land, a much greater amount of nutritive matter than the cereals. Professor Johnston, in his 'Elements of Agricultural Chemistry,' estimates that 'If an acre of land yields the following quantities:—

Of Wheat, 25 bushels, or 1,500 lbs.
Of Potatoes, 12 tons, or 27,000 lbs.

the weight of dry starch, sugar, gum—of gluten, albumen, casein—of oil or fat, and of saline matter reaped in each crop will be represented very nearly by the following numbers:—

	Woody fibre	Starch, sugar, &c.	Albumen, gluten, &c.	Oil or fat	Saline matter
Potatoes . . .	220	825	180	45	30
Wheat	1350	3240	600	90	240

If it be granted that the quantities above stated are fair average returns of the two kinds of produce

from the same quality of land—that the acre, for example, which produces 25 bushels of wheat will also produce 12 tons of potatoes—then it appears that the land which, by cropping with wheat, would yield a given weight of starch, gum, and sugar, would, when cropped with potatoes, yield about four times as much. In other words, the piece of ground which, when sown with wheat, will maintain one man, would support four if planted with potatoes, in so far as the nutritive power of these crops depends upon the starch, sugar, and gum they contain.'

Mr. Alfred Smee, in writing on 'The Chemistry and Uses of the Potato,' states:—'The potato is valuable to man as an article of food from the starch and albumen which it contains, as these two principles can effectually nourish the human being. The one acts by combining with oxygen in his lungs to give him warmth, the other nourishes his muscular system and fits him for labour.

'Neither principle alone would suffice, for man would starve upon either one: it is the combination, then, which is valuable, and we find that this combination cannot be produced at so cheap a rate from any other source.

'The nitrogenised portion is the most costly to buy, and we find that the relative value of the potato, in point of weight, with other substances is as follows:—

Wheat flour	100	Maize, or Indian corn	138
Barley	130	Peas	67
Oats	117	Potatoes	613
Rye	111	„ dried at 212°	126
Rice	177	Jerusalem artichokes	539
Buckwheat	108	Turnips	1338

These are termed nutritive equivalents, 613 parts of potato being equal to 100 wheat, flour, &c.'

Thus the potato as an article of diet is invaluable, as it contains hydrogen, carbon, nitrogen, phosphorus, sulphur, iron, and lime—all elements required for nutrition. There is no doubt that Professor Johnston's estimate of twelve tons per acre is much below what might be grown, more especially since the introduction of the American varieties, they, as a rule, being much heavier croppers than the English kinds.

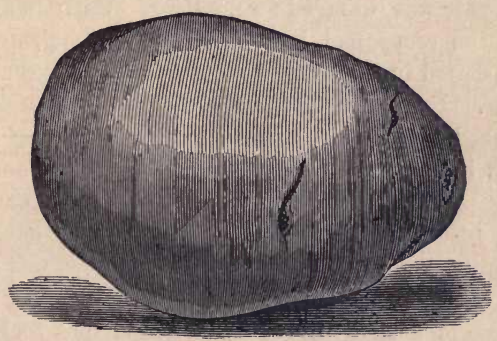

Fig. 1.—TROPHY. Introduced 1878.

In a paper read by Mr. Knight before the Horticultural Society, so far back as the year 1828, he stated that he had succeeded in growing 24 tons, 6 cwt. 98 lbs. per acre of the ash-leaved potato, and he believed that 36 tons might be grown.

If this amount of produce could be obtained fifty years ago, surely we ought to be able, with all our improved appliances in agriculture, and the new varieties of potatoes that have since been introduced, to equal, if not to exceed, that weight per acre; and there is no

reason why this should not be done, provided we bestow upon its culture that thought and care which the plant so richly deserves.

Just as the potato is the most useful of our vegetables so has it received the worst treatment of them all. Could we devise any method of culture worse than the following, which has been carried out in this neighbourhood, and which is a fair specimen of the practice usually adopted by the agriculturist. A large field upon which wheat and barley had been grown the previous year was intended for potatoes. Early in autumn, after the crops had been taken off, the gratten was broadshared in the usual way, and so left through the winter. In spring, a coat of farmyard manure was ploughed in about six inches deep, and the furrows struck by the plough in the usual manner, the tubers being planted one foot by two. Towards the end of May, just as the tops were coming through the soil, the ridges left by the plough when the seed was covered in were levelled down by a short-tined harrow, for the purpose of destroying the small weeds that had begun to grow. But not only were the weeds eradicated, but the fibrous roots and stolons that the plants had begun to throw out from their main stems were destroyed also. The soil being drawn away from the plants, the blanched stems now stood bleak and bare nearly three inches out of the soil, and some of the tubers were laid entirely bare; and so they were left, till in due time the brake was run through them, and they were afterwards earthed by the plough, the stems being buried to about the same depth as before the harrow was put over the field, the consequence being that the

plants had to do their work over again, by throwing out new stolons and rootlets.

Yet under such treatment the potato is expected to produce a remunerative crop, and when it fails to do so the farmer is apt to blame the potato, when it is his mode of culture alone which is entirely at fault.

CHAPTER II.

NATIVE HOME OF THE POTATO—ITS INTRODUCTION—BY WHOM INTRODUCED—EARLY OPINIONS RESPECTING IT—DATE OF ITS FIRST CULTIVATION.

When a new species of plant is first placed in our hands, we naturally ask, whence does it come, and what is its natural habitat? and we do this that we may the better understand the general treatment it is likely to require.

So in beginning to write about the potato it seems almost impossible to dash off with a few strokes of the pen into the theory and practice of its culture. One wants to know, from whence came the potato, by whom, and from what sunny land was it introduced to our comparatively cold and ungenial clime?

The potato (*Solanum tuberosum*) is a native of South America, and is found growing wild over a large tract of country on the western side of the Southern States, especially in Peru, Ecuador, and Chili. In its natural state the plant grows very luxuriantly, the stems growing to the height of five or six feet, and even more, on the edge of swamps and moist situations, where they often become recumbent, taking fresh root in the soil, and thus forming large and luxuriant masses of foliage. The tubers, of which there are both red and white varieties—or rather yellow-skinned sometimes blotched with red—are small and uneven in shape, and

very sparingly produced, varying in size from a small marble to a bantam's egg. They are called by the natives of Chili, Maglia.

The potato was grown on the Continent of Europe some years before it was known in England, having been introduced into Spain from Quito by the Spaniards in the earlier part of the sixteenth century. Clusius, a botanist of Vienna, is reported to have received it from Mons in Belgium in 1598, and he states that its culture spread rapidly throughout Germany.

Probably, the point as to whom we are indebted for the potato, and the date of its introduction, will never be fully cleared up; and as the various writers differ so widely on the subject, no reliance can be placed on the dates given by them.

The first really authentic account we have of the potato is from the 'Herbal,' published in 1597 by Gerard, a celebrated botanist of that date, and gardener to Lord Burleigh. He there gives a figure (see fig. 2) of the potato under the name of 'Batata Virginiana' which he had grown in his garden at Holborn; he says: 'The root is thick, fat, tuberous, not much differing in shape, colour, and taste from the common potato, saving that the roots hereof are not so great nor long: some of them are as a ball, some oval or egg fashion, some larger, some shorter, the which knobby roots are fastened into the stalks with an infinite number of thready strings.'

The common potato here mentioned is Batatis edulis, belonging to the natural order Convolvulaceæ, and although Johnson and Paxton give the date of its introduction as 1797, it is quite evident that it was

Fig. 2.
THE WILD POTATO, as grown by Gerard, and figured in his 'Herbal,' published 1597.

common in England in Gerard's time, as he gives a figure of this plant also. This is likewise the plant referred to by Shakespeare in 'The Merry Wives of Windsor,' where he makes Falstaff say, 'Let the sky rain potatoes.' The word 'potatoes' also occurs in 'Troilus and Cressida.'

The first man whose name is connected with the introduction of the potato is John Hawkins, the introducer of the slave trade into America (afterwards Sir John Hawkins), who is said by some writers to have brought home the potato in 1545, but more probably in 1562, that being the date when he took his first cargo of slaves from Sierra Leone to South America, exchanging his negroes with the Spaniards for the commodities of the country, such as hides, sugar, and ginger, and possibly tubers of the potato plant. If so, it is quite within the line of probability that he may have introduced the potato into Ireland, but there are no facts whereon we can rely.

There appears to be no doubt that tubers were brought home by Sir Francis Drake, and presented to Sir Walter Raleigh, in 1586, under the following circumstances:—

Several unsuccessful expeditions had left the English coast for discoveries in the New World previous to the year 1585, when Sir R. Grenville proceeded to Virginia, and having visited Cape Hatteras, and Roanoke, he embarked for England, leaving 107 persons under the government of Mr. Lane, who formed the first English colony ever planted in America. But the colonists, led away by the fictitious statements of the natives, wasted their time principally in the search for gold, so that

when Sir Francis Drake visited them on his return from a successful expedition against the Spaniards, in the West Indies, he found them in the greatest extremity, so much so that he brought the entire colony with him to England. It being on his return from this voyage that Drake presented the potato tubers to Raleigh, hence the mistake of some writers, who erroneously state that the potato was brought from Virginia by the returning colonists.

Gerard falls into this error when he says, 'I have also received roots thereof from Virginia, which grow and prosper in my garden as in their own country.'

The popular belief is that the potato was introduced into this country from Virginia by Sir Walter Raleigh; but if we examine the subject more closely we shall find that, probably, Raleigh saw the potato growing for the first time in Ireland, the produce of the tubers brought home by Drake in 1586.

It is stated that Sir Walter had them planted in his garden at Youghal, and seeing them in apparently good condition, he told his gardener to send him a dish. The gardener plucked the green apples, which were sent to Sir Walter's table, who, finding them very disagreeable, directed that the plants should be destroyed.

Now it is evident that had Sir Walter Raleigh previously seen the potato growing in its natural state, he would not have made the mistake of attempting to eat the fruit or seed pods, which are of a poisonous nature, and grow on the top of the haulm, but would have known that it was the tubers growing at the root of the plant which were edible.

There is no doubt that Sir Walter Raleigh had

nothing to do with the introduction of the potato, but he may have been the first man who brought it under cultivation in this country.

It is also well known that the plant is not indigenous in Virginia, neither is it found in its wild state in any part of North America, and as all previous attempts at colonisation had ended in disastrous failures, the potato could not have been received from Virginia, but, as we have shown, Drake brought the potato to Ireland on his return voyage from South America.

The potato grown by the natives of Chili and Peru at the present day differs from the wild variety only so far as its productive powers have been increased by culture, and there is little doubt that the potato was cultivated by the natives of South America (however primitive might be their method of culture) at the time of the discovery of the New World by Columbus; and tradition says that he brought tubers of the potato with him on his return. However that may be, it is most probable that Columbus found the potato grown by the Indians and used as an article of food, and his attention would, as a matter of course, be attracted thereto; and when Peru was annexed to Spain by Pizarro, the colonists imitated the Indians by planting the tubers received from them, as the quickest and easiest means of obtaining an immediate supply of food; and on the introduction of slaves from Africa by Hawkins its culture became of still greater importance, so that, by the time of Drake's expedition in 1585, its tubers had become a commodity of considerable value to the colonists, and he most likely obtained them as an article of food for his crew on his homeward voyage.

The potato had not received an English name prior to 1597, and that is probably the reason that we hear nothing of it from previous writers. Gerard gave it the name of 'Potato,' when publishing his 'Herbal,' on account of the resemblance of its tubers to the sweet potato; and he describes it as 'an excellent thing for making sweet sauces, and also to be eaten with sops and wines.'

It was not brought under general cultivation until the middle of the seventeenth century, when it met with a great amount of prejudice not only in this country but also on the Continent, where in many places it was publicly interdicted as a 'mischievous and poisonous root,' and the first man who attempted to bring it into use as a matter of food in France was severely pelted with his own tubers by the populace.

By the beginning of the eighteenth century it was extensively cultivated in England; but it made little progress in Scotland on account of the bigotry of the people, who argued that it was a sinful plant because it was nowhere mentioned in the Bible; and it was not till 1728 that the first field crop was planted in that country by Thomas Prentice at Kilsyth.

CHAPTER III.

SOILS—PREPARATION OF SOIL—DOUBLE DIGGING: ITS ADVANTAGES.

Not only has the potato the widest geographical range of any cultivated plant (Humboldt states in his 'Travels' that it is found from the southern extremity of Africa to Labrador, Iceland, and Lapland), but it is also one of the most convenient vegetables with regard to its culture, and will thrive on a greater diversity of soils than any plant in cultivation. There is no soil, from the bog or peat earth, with its 70 to 75 per cent. of organic matter, and upon which no other plant can be made to produce a remunerative crop, to the clayey soil, with only from 3 to 5 per cent. of organic matter, upon which the potato, if properly cultivated, may not be grown with more or less satisfactory results.

The soil that is generally considered to be most suitable for the cultivation of the potato, is a light sandy loam, with a good natural drainage, and with a gentle slope towards the south; but as all soils differ in their texture, and it is rare to find a soil just as we would have it, so we endeavour, by tillage, by manuring, and by exposing the soil to the pulverising influence of the atmosphere, to improve its texture and thereby its fertility.

Theory and practice alike demonstrate that heavy

and tenacious soils, and those that are rich in vegetable matter, cannot be too often moved, provided this be done when they are in a comparatively dry state: the object being to allow the sun and air to have free access to all parts of the soil, the heat-rays of the sun penetrating, breaking down, and pulverising the soil; while there is no doubt that the chemical rays have also great influence on its fertility by assisting to convert the inorganic constituents that may be present in the soil, from a chemical to a physical combination, so that they can be taken up and assimilated by the growing plant. However rich a soil may be in animal or vegetable matter, its fertility depends in no small degree on atmospheric pulverisation. When exposed to air and moisture, animal and vegetable matters rapidly decompose; the various combinations of gaseous forms, that are not usually taken up by the roots of plants, make their escape from the soil into the air, leaving behind the carbonaceous matter, and the various earths and alkalies that constitute the food of the future plant.

The well-being of the crop depends to a far greater extent than is usually anticipated upon the thorough subdivision of the soil by mechanical means, in order that the several manures, whether animal, vegetable, or mineral, may be minutely divided, and thoroughly incorporated with the natural soil. Every hard clod of earth that is left unbroken is just so much soil wasted. It is true there is the bulk of matter, but if the clod be examined at the end of the growing season, it will be found that no rootlets have penetrated the hard mass of earth.

It is the rule rather than the exception, in some parts of the country, to see a large portion of the soil in which a crop is growing wasted from this cause—*bad tillage*. Yet tillage is the very first principle of good culture; and there is nothing new in this, for Cato, who lived before the Christian era, wrote, 'Wherein does a good system of agriculture consist? In the first place, in thorough ploughing; in the second place, in thorough ploughing; and in the third place, in manuring.' Theory, practice, and science confirm this principle at the present day.

A short time since a celebrated agricultural chemist, speaking before a large body of practical men on experiments that had been made with manures, said: 'I cannot too strongly impress upon you that manures are but a secondary object to attain the desired end. Good tillage and a thorough pulverisation of the soil are the first principles of culture, without which manures lose half their value.'

In preparing the land for the ensuing crop of potatoes it is especially desirable that the soil should be well pulverised, for tubers of first-class quality and shape, such as are shown at our great potato exhibitions, are never taken from an unkindly soil, and if we wish to succeed at the exhibition table, and to grow remunerative crops, we must take advantage of every means of improving the texture and productive properties of the soil.

To grow potatoes well, the land should be prepared as early in autumn as circumstances will admit, deep culture of the soil being favourable to the development of the rootlets, and giving them an opportunity of pene-

trating deeper into the soil. Of the several methods resorted to for this purpose double-digging is the most preferable, as it gives the advantage of improving the depth of the soil by placing the manure in the second spit, retaining the top spit, which is usually lighter and more friable, for the young tubers to form in.

Double-digging is well understood by the gardening fraternity, but as there may be some amongst amateurs to whom the principle is somewhat new, a detailed account of the process may not be out of place. Having selected the piece of ground on which potatoes are to be grown, the manure that is to be dug in with the bottom spit should be spread over the ground. For this purpose the refuse of the garden is excellent, such as old cabbage and cauliflower stalks chopped to pieces, the clearings of asparagus and seed beds, and, in fact, any of the offal and waste—excepting cuttings of trees —that usually accumulates in a garden, which, instead of being burnt, as is usually the case, would be much more effective if dug into the soil. If farmyard manure be applied, it should be in a thoroughly decomposed state, for strong rank manures of animal origin should never be used for the immediate crops of potatoes. We will suppose the piece of ground selected for the operation to measure 12 yards by 6. After marking out the ground a line should be stretched down the centre, to divide it into two parts, which we will call A and B. (See Fig. 3.) The top spit should be taken off, 3 feet wide and 12 inches deep, at C, placing the soil that is taken out at D: the first trench would then be ready for the manure. The next trench, E, should then be marked out, 3 feet wide as before, putting the manure that has been spread

over the ground into the open trench, C. A shovelful of hot lime thrown in with the manure will greatly aid its decomposition, and assist to eradicate vermin. The bottom spit of trench C should then be broken up also to the depth of 12 inches, well mixing the manure with the soil. Having broken up the bottom spit of the first trench, C, the top soil should be taken from the second trench, E, again to the depth of 12 inches, and

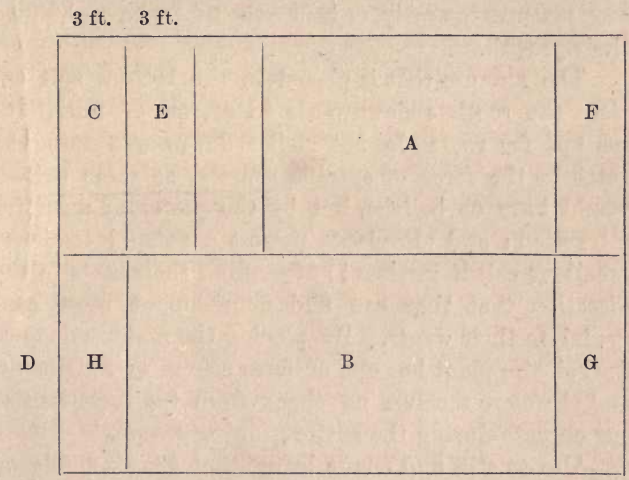

Fig. 3.

placed in the first trench, C, which is then finished. So trench after trench should be taken out 3 feet wide and the manure dug in, as in the bottom of the first trench, until the trench F is reached. The other half of the ground which is marked B should then be set out in like manner, the soil of the top spit of the first trench, which is opened at G, being used to fill up the open trench, F; and so continue as in the first half of

the ground until the last trench, H, is reached, which must be filled up with the soil that was taken out of the first trench and laid at D, when the work will be completed.

This method of preparing the land is especially adapted to the culture of the potato on light and sandy soils, which, if the weather be hot and dry, part with their moisture too freely by evaporation, so that the crop matures too early, or before the tubers have obtained their growth.

The manure that is placed in the bottom spit entices the rootlets downwards in search of nutritious matter, for roots do not strike downwards into the earth by the force of specific gravity, as some writers would have us believe, but by the power of nutritive attraction; and all plants possess a natural tendency (shall we call it instinct?) of sending their roots in the direction that they can find nourishment most congenial to their wants. By placing the manure deep in the soil the plant has one uniform source of nutriment, and therefore receives no check from the variations of our climate during the entire growing season.

Also on stiff and heavy loams that have a tendency to retain the water that should pass away by drainage, the manure that has been mixed with the second spit of earth keeps the soil open, and allows the water to pass freely beyond the reach of the roots. This method not only gives the advantage of securing a good crop the first season, but also adds to the permanent fertility of the soil by adding to its depth, and thereby changing its relation with respect to moisture and temperature.

CHAPTER IV.

MANURES AND MANURING—ANALYSIS OF THE POTATO TUBER —GREEN CROPS AS MANURE—SPECIAL ARTIFICIAL MANURES.

In digging the piece of ground we have divided the soil into two strata, which we have called the top and bottom spits, each twelve inches deep, which gives a uniform depth of twenty-four inches, into which the roots of the plant will have full access. In the lower stratum we have placed a quantity of animal and vegetable manure, leaving the top spit or upper stratum as the receptacle of any further manures it may be thought desirable to apply.

Should the land be poor and deficient in vegetable matter, a good dressing of well decomposed vegetable manure may be added. Poor soils never produce a good crop, neither are the potatoes of first-class quality, for vegetables, like the flesh of animals, are always deficient in flavour if they have been half-starved.

On stiff soils any substance that serves to render them less adhesive may be applied with benefit: such as old mortar rubbish, charcoal dust, burnt earth, ashes, lime, decayed leaves, &c. They should be applied as early as circumstances will admit, and well incorporated with the soil, which should be allowed to remain as rough as possible. In frosty weather it should be forked

over, that it may get the full benefit of the frost and air, which not only assists to pulverise the earth, but also destroys insect life, especially the wire-worm, which is the greatest pest, of all insects, to the potato.

The culturist should have a thorough knowledge of the capabilities of his soil, and of its components, and also of the inorganic constituents of the various plants that he intends to grow upon it. It is the lack of knowledge on this subject that makes fallow and the rotation of crops necessary, for 'upon the correct knowledge of the bases and salts requisite for the sustenance of each plant, and of the composition of the soil upon which it grows, depends the whole system of a rational theory of agriculture.'

Baron Liebig says: 'A time will come when plants growing upon a field will be supplied with their appropriate manures, prepared in chemical manufactories; when a plant will receive only such substances as actually serve for its food, just as at present a few grains of quinine are given to a patient afflicted with fever, instead of the ounce of wood, which he was formerly compelled to swallow in addition.' This prophecy is in a fair way to fulfilment, for in these days of progression culturists are asking themselves what is the best manure to apply to this or that crop, so as to obtain the most remunerative returns? and the more we become acquainted with the science of manure and manuring the less waste will there be upon our farms and gardens.

Farmyard manure possesses all the properties of which plants are composed, but it does not possess the mineral or inorganic constituents in the relative proportions to the wants of various plants; hence the value of adding to the land, special manures in a concentrated

form, in accordance with the requirements of the particular plant intended to be grown upon it. 'A fertile soil must contain in sufficient quantities, and in a form adapted for assimilation, all the inorganic materials indispensable for the growth of plants' (Liebig).

But different kinds of plants take up in different proportions the various inorganic constituents of which they are composed: for instance, the ashes of peas contain 30 per cent. of soda, while the potato contains only a trace; the ashes of wheat contain 50 per cent. of phosphoric acid, but peas contain only 8, and potatoes 12 per cent. Thus we see the necessity of applying the special inorganic, or mineral, manures, in proportions and according to the requirements of the various kinds of plants.

The word 'manure' applies to all matters, whether of animal, vegetable, or mineral origin, that constitute the food of plants, and in manuring the land we are but placing upon it the dead and unorganised matter that constitutes and builds up the living plant, and the nearer the plant has been supplied with its requisite components, to the greater perfection will it arrive.

The inorganic constituents of the potato tuber, as contained in 1,000 lbs. of the ash, are as follows:—

Potash	557
Soda	19
Lime	20
Magnesia	53
Oxide of iron	5
Phosphoric acid	126
Sulphuric acid	136
Silica	42
Chlorine	42
	1,000

The above analysis shows the proportions of the various inorganic substances that have been abstracted from the soil by the plant while growing.

Potash, the alkali of land plants, largely predominates, hence the special value of wood ashes as a manure for potatoes. Phosphoric acid is of animal origin, and is supplied to the soil in all bone manures; it is of especial value when applied to cold and wet soils, as it has a tendency to induce early ripening of the tubers.

Caustic lime, independent of its food-giving properties, is of great benefit to the land, by improving its texture, and by dissolving vegetable fibre and rendering it soluble. It is therefore especially adapted for applying to land that contains an excess of organic matter, such as peaty soils, and old pastures that have been broken up; and in many of our gardens it might be more liberally used with advantage. It enters largely into the composition of the foliage of the potato. Lime has also a very beneficial effect on light and sandy soils on account of its power of absorbing moisture. Respecting this Dr. Voelcker observes: 'The most liberal application of farmyard manure of the best quality never produces so beneficial and lasting an effect on poor sandy soils as when they have been well marled or limed. There are some soils which swallow up manure, with, so to speak, no satiable appetite, without ever feeling the better for the manure; they are appropriately called 'very hungry.' On all such soils I have no hesitation in saying much manure is wasted, or the most is not made of it, if, previously to the application of farmyard manure, guano, &c., the land has not received a good dose of marl or lime.

Common salt, which contains about sixty per cent. of chlorine, should be used with great care as a manure, and especially on cold and wet land. It may sometimes be used with great advantage on light dry soils, where the potato has a tendency to ripen too quickly, as it retards its ripening properties, but it enters very slightly into the composition of the plant.

The cultivation of green crops for manure is as a rule greatly neglected, yet they are very valuable to the land, and easy to obtain, for by sowing a little mustard or cole seed at the end of the season, a crop several inches high is obtained, which can be dug or ploughed in with advantage. As a manure for potatoes, green crops are beneficial both to stiff and sandy soils. They render the tenacious clays less adhesive, and add to their productiveness by allowing the rootlets freer access to all their parts in search of food, while in sandy soils a certain cohesion is produced, which assists them to attract and retain moisture. Of course the soil would be neither richer nor poorer by growing on it green crops for manure, so far as the inorganic constituents are concerned, as there will only be put back into the soil what was taken out of it by the plants, but the quantity of organic or vegetable matter will be materially increased.

Artificial manures, when judiciously supplied, are invaluable aids to good culture; they should contain all the inorganic constituents of the plant to which they are to be applied, in relative proportions and in an assimilable form, so that they may be at once taken up by the growing plant. It is beyond doubt a great mistake to apply the same kind of artificial manure to all

crops, for plants differ both in the kind and quantity of the inorganic constituents they take up, so that the manure which would produce the most valuable results when applied to one kind of plant, would produce little or no effect on another. The potato contains, as we have seen, potash, soda, lime, magnesia, oxide of iron, phosphoric acid, sulphuric acid, silica, and chlorine, in different proportions; and as one ton of potatoes, as lifted from the soil, contains about 25 lbs. of ash (which represents the inorganic or mineral food of the plant), supposing an acre to produce 10 tons of potatoes, there will be taken from the soil by the tubers alone 250 lbs. of matter per acre, in very nearly the following proportions:—

Potash	141
Soda	5
Lime	5
Magnesia	13
Oxide of iron	1
Phosphoric acid	31
Sulphuric acid	34
Silica	10
Chlorine	10
	250

Some soils contain one or more of these constituents in abundance, so that it would be waste, and in some cases, very injurious to add more of that substance of which there is already an excess; yet being deficient of others, without which it is impossible for the plant to arrive at perfection, special artificial manures become a necessity, for, by their means, those constituents of which the soil is deficient can be supplied in the exact

proportion required, for the success of every crop depends on the presence, in an available form, of all the mineral constituents of which the plant is composed.

A distinction should be drawn between those manures which contain the necessary mineral food of plants, and those that contain only elementary substances, which act as stimulants. Stimulants are beneficial to some crops, particularly where luxuriant foliage is required, but when applied to the potato in excess, their action is often of a decidedly injurious character, for by inducing a strong and rank foliage the plant is rendered more susceptible to disease, and the quality of the tuber is never so good when stimulating manures have been applied to the growing plant.

CHAPTER V.

DEGENERATION OF THE POTATO—ITS CAUSES—SELECTING SEED TUBERS—SINGLE EYE CULTURE—ITS ADVANTAGES—CUTTING THE POTATO INTO SINGLE EYES.

When a new and improved seedling potato is first brought into general cultivation, it usually possesses a vigorous constitution, and large productive powers. For the first year or two special care is devoted to its culture, and to the tubers after they are lifted. We speak in glowing terms of this new variety, we admire the beauty of its foliage, the symmetrical form and fine texture and flavour of its tubers, and above all, its extra cropping qualities.

But in a few years, in all probability, it has fallen to the level of an average variety, and we say that the potato has degenerated. That it does degenerate there is no doubt, but is there any one subject, either in the animal or vegetable kingdom, but would have degenerated or, more probably, ceased to exist, under such treatment as the potato has received at our hands?

It has been the practice to select for propagation the refuse of the potato heap; small, immature, ugly, ill-shaped tubers have been considered good enough for seed; and when the result has not met our expectation we have raised the cry that the potato is degenerating. In carrying out this practice for years, was it

possible to arrive at any other result? It is one of Nature's universal laws, that when man neglects or abuses her, she falls back to her normal condition. But the very art of gardening is to lift Nature above her normal state, by good culture, by raising new and improved varieties from seed, and by selection.

Shakespeare says:

> 'This is an art
> Which does mend Nature; change it rather: but
> The art itself is Nature.'

We endeavour to improve our various kinds of vegetables, such as carrots, parsnips, onions, beet, &c., by selecting year after year the finest and best-shaped roots for seed-bearing purposes, knowing that the seedling will partake more or less of the good qualities of the parent, and this rule holds equally good in selecting potatoes for seed. When we plant the germ of any kind of potato, we do not obtain a new variety, as we do from seed, but by carefully selecting good-shaped, well-ripened tubers for planting, we shall not only keep the variety to its original standard of excellence, but by continuing the practice we shall ultimately improve it by selection.

> 'Still will the seeds, tho' chos'n with toilsome pains,
> Degenerate, if man's industrious hand
> Cull not each year the largest and the best.
> 'Tis thus, by destiny, all things decay,
> And retrograde with motion unperceived.'
>
> KENNEDY'S *Virgil's Georg.*

The method of selection is peculiarly adapted to the principle of growing from single eyes. If we take an average good-shaped potato, weighing from 6 to 10 ozs.,

we shall find that it has from 12 to 18 eyes, which, if cut into single eyes, would give as many sets, which would naturally produce a more even sample of young tubers than the same number of whole sets of odds and ends that have been considered neither large nor good enough for cooking.

The principle of growing from single eyes has two great advantages, namely, economy of seed, and, upon suitable well-tilled land, a larger crop of marketable potatoes. When whole tubers are planted, two or three eyes start into growth first; these keep the lead during the entire growing season, and from their stolons the largest potatoes are produced; the weaker eyes start later into growth, and produce only small tubers of little value; but when single eyes are planted, the whole strength of the set is devoted to one growth, all the young tubers are formed at nearly the same time, and, the plant having no other calls on it for nutriment, these continue to grow and form large tubers.

The whole tuber produces the largest number of potatoes, but the single eye will produce the most uniform sample, and the heaviest crop per acre.

A series of experiments were carried out in the gardens of the Horticultural Society, under the direction of the late Professor Lindley, with a view to ascertain the relative productiveness of tubers and sets, respecting which he says: 'We selected a piece of ground of quality as nearly uniform as possible; it was divided into four-feet squares, and in the centre of each square was planted either a tuber, or a single eye, or a set containing three eyes, or the whole surface of a tuber pared off so as to leave the eyes safe, but to remove the

centre: a practice which is not uncommon in Scotland. . . . . If we consider the results of the whole sixteen experiments as being but one experiment, we shall find their proportions expressed by the following figures:—

Whole tuber	338·38 or 2	nearly.
Single eyes	717·87 „ 11	
Three eyes	613·94 „ 5	
Parings	504·69 „ 4	

It would therefore appear, if these experiments can be deemed conclusive, and I confess I can discover no probable source of error, that the opinion which has been entertained of the superior productiveness of tubers over sets is unfounded.'

Lord Portman, writing to Ph. Pusey, Esq., respecting the potatoes grown at Bryanston, remarked: 'The most regular crop was produced by the eyes which had been scooped from the tubers a short time only before planting'; also: 'That in spring planting, eyes fresh scooped from the tubers are as certain to produce a crop as larger sets, but they should be planted in land well manured and in fine tilth, and not set deeply in the soil.'

In adopting the principle of single eye culture, it is requisite that the eyes should be taken from large or average size potatoes, for the smaller the tuber the weaker are its producing powers. The crown eye always grows the strongest, and produces the largest potatoes, often approaching to coarseness, while those taken from the middle or body of the potato produce the best-shaped and most uniform tubers.

Some kinds of potatoes are better adapted to this

mode of culture than others, especially the American varieties, on account of their vigorous habit.

The Lapstone and Ashleaf families are exceptions, as they will not thrive well when cut. When extra good samples of Lapstones are required, all the eyes but two should be scooped from the seed tuber, thus concentrating the strength of the plant to the two growths.

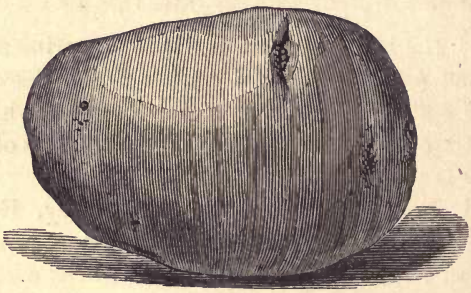

Fig. 4.—Lapstone.

There are several ways of cutting a potato into single eyes; the principal thing to aim at is to obtain a fair share of the flesh of the tuber to each eye, with the least amount of cut surface. The American method of cutting the potato is probably the best, and it is the one now universally adopted. The following is a description of the method as given by Mr. B. K. Bliss, of New York:—

'Take any potato and hold it before you with the stem end (the place where it was joined to the vine) down. It will then be noticed that the eyes are arranged around the tuber in regular ascending rotation from the bottom to the top, similar to the thread of a corkscrew, each eye being a little above and further

around the side than the one next below it. Now take the potato in the left hand with the stem end down, keeping it in a perpendicular position throughout the entire cutting. Take a sharp thin-bladed knife and remove the first eye by placing the knife about equally distant between it and the eye next in rotation above it, sloping it to the indenture left by the stem (see dotted lines in centre cut), removing the flesh with it. When the first eye is removed, turn the potato around

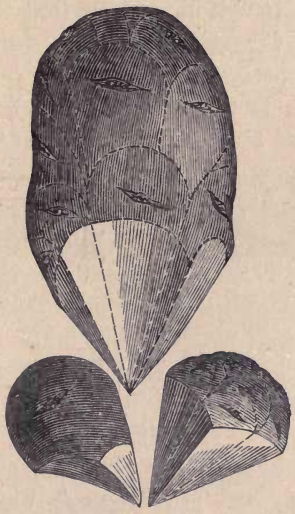

Fig. 5.

in the hand until the next eye above appears. Remove this one in the same manner, and keep on turning the potato, removing each eye as it appears in exact rotation, always sloping the knife to the stem. After three or four eyes are thus removed the bottom part of the tuber will have a somewhat pyramidal form (see Fig.

5). It will be noticed that each eye removed has a similar form to that represented by the cut on the left, and has its proportionate share of the flesh attached.

'After the first two eyes are removed no further trouble will be found until the seed end is reached, and only a little extra care will be required to remove those closely clustered eyes. The cut on the right represents what remains of the potato after all but the small eyes are removed, while the dotted lines show how to separate each of these. It will be noticed that the base retains the same form throughout, and by sloping the knife each time, and cutting down to the apex of this inverted pyramid (which is the centre of the tuber), each eye will be supported by an equal amount of the flesh, which is to start it into a strong, healthy growth.'

The sets should be planted as soon as cut, and a little hot lime thrown over them will absorb the moisture, prevent premature decay, and also the attack of insects.

Land that is with difficulty brought under cultivation, such as stiff clays, cold and wet undrained soils, and all land that is under an indolent method of tillage, will not be found suitable for single eye culture, for in consequence of the sets being small, some of them would probably rot before vitality commenced in the germ: therefore, under these circumstances, whole sets become a necessity.

Seed tubers should not weigh less than three to four ounces; and to obtain the best results all the eyes but three should be cut out, thus restricting the strength of the plants to the three growths, but in general culture it is almost impossible to carry out this principle.

CHAPTER VI.

PLANTING—RIDGE PRINCIPLE—FLAT PRINCIPLE—DISTANCE OF PLANTING THE SETS—EXPERIMENTS WITH POTATO SETS—AFTER CULTURE—IMPLEMENTS—EARTHING.

No positive rule as to the time of planting can be laid down, it must of necessity vary in different localities and situations. In the south-eastern counties of England the most suitable time to plant the general crop is the last week in March, or the two first weeks of April. This gives the advantage of devoting more time to the preparation of the soil, for after being dried by the March winds it can be forked over with great advantage. Where it is thought desirable to add artificial manures this would be the best time to apply them, well incorporating them with the soil.

The well-being of the crop depends far more upon the condition of the soil than upon early planting, and it is better to defer planting until the end of April, and to obtain a good season, than to plant in a soil that is unkindly, and which has not been well exposed to atmospheric influences.

There is no advantage in too early planting, particularly in stiff soils, for the cold rains of early spring cause the soil immediately around the seed to become hard and unkindly, and it often happens that potatoes which have been planted in February or early in March

make their appearance above ground before we are clear of spring frosts, and just as all the organs of the plant are called into activity (the young leaves absorbing atmospheric nutrition, and the rootlets hard at work collecting the inorganic constituents and sending them up into the plant for assimilation) the foliage is cut down to the ground by frost, thereby causing a check to its growth from which it never entirely recovers. When the young plants have been severely injured by frost they will not produce so heavy a crop by one-third as they would have done had they continued their growth unchecked.

There are two principal methods—the flat and the ridge—of planting and growing the potato, each depending on the variety of soil on which it is intended to plant.

The ridge principle of growing potatoes possesses certain advantages on tenacious and wet lands. The temperature of the soil is improved by the superfluous moisture being drained off into the trenches, and by a greater surface being exposed to the influence of the sun and atmosphere; the air freely circulates amongst and dries the foliage, thus assisting to check the attack of disease, and inducing a sturdy habit of growth. The quality of the tubers is also improved in consequence of the soil being drier and warmer, for one of the greatest drawbacks to growing potatoes on stiff soils is their retentive properties. Yet even on such soils, by adopting this principle, large and remunerative crops are produced which well repay the extra labour and care bestowed.

The soil should be well prepared by manuring and

digging, omitting no opportunity of applying any matter within reach that would tend to lighten and improve its texture.

All being ready for planting, and choosing a fine day for the operation, the distance it is intended to plant the rows apart should be marked out; 4 feet 6 inches between the rows being the best distance for all strong and average growing varieties, thus allowing 3 feet for the ridge and 18 inches for the trench, from which the earth is to be taken for covering the sets, which should be placed on the surface of the soil from 12 to 18 inches apart in the rows, the distance being regulated by the size of the sets and the strength of the variety.

The trenches having been marked out 18 inches wide, the soil should be dug out, throwing the spits right and left alternately, covering the sets to the depth of about 3 inches, and forming the ridge in which the potatoes are to grow. In taking the earth from the trenches, care should be taken not to throw heavy unbroken spits of soil directly on the sets, but it should be placed close by them and well broken with the fork —the finer the better—and then placed lightly over the seed.

As soon as the plants are well above ground earthing operations should be commenced by taking more earth from the trenches and carefully placing it round the stems, and as the plants continue to grow this should be repeated from time to time until the sets are buried to the depth of from 8 to 10 inches. The soil should be well broken up in the trench before using, and some care is required not to break or bruise

the foliage while earthing up, for which a shovel is the best implement. The ridge should not be carried to a sharp angle, the top being left about a foot wide and nearly flat.

The trenches can also be utilised by growing in them celery, broccoli, or Brussels sprouts, for the ground must be bad indeed that will produce only one crop in a year under spade culture.

The flat principle of culture is that usually adopted upon light, free, and medium soils; it consists of planting the sets from 2 to 6 inches deep, according to the constitution of the soil. In very light and sandy soils, that part with their moisture freely, the sets should be planted at the greatest depth, but in medium and stiff loams 2 to 3 inches will be found sufficient.

There are also two principal methods of arranging the sets in planting, either in single hills or in drills. Single hills are best adapted for growing new and valuable varieties, where the object is to obtain as large a produce as possible from a limited quantity of seed; but when we wish to obtain the largest crop possible from a given extent of land, planting in drills is more suitable.

In gardens where large breadths of potatoes are to be planted, a hand-plough for drawing drills is a most useful and economical instrument. It consists of two pieces of oak board nailed together in the form of a triangle, forming what may be called a miniature snow-plough, with a single handle, the depth of the drill being regulated according to the pressure applied; but for all ordinary-sized gardens the two-pronged hoe is the best implement for the purpose, by which, in the

hands of a man who has had a little practice, drills to the required depth can be drawn with ease and expedition.

The sets should be carefully regulated and placed eye uppermost in the rows, which is of consequence when small cut sets are used. Manure should never be placed in the drills with the seed, as it serves to contract the roots to a centre, which is always objectionable; and some artificial manures, if brought into immediate contact with the young tubers, burn or scald their tender skins, often causing them, when lifted, to present a scabby appearance. It is much better that all manures be applied before planting and well mixed with the soil, thus encouraging the plant to extend its root action.

It is often of great advantage, in soils where the wire-worm is troublesome, to place small pieces of rape cake in the rows at regular distances, and by marking the places they can be taken out about the time the plant comes through the soil, when they will be found to be literally alive with the insect, which appears to have a great liking for rape, and will leave any other substance when that is within its reach.

The distance between the rows should be graduated according to the kind of soil and the variety of potato, whether of dwarf or strong growing habit. No advantage is gained under any circumstances by too close planting, especially on good soils.

Strong-growing varieties—represented in the English division by Magnum Bonum (Fig. 6), and in the American by Superior—although abundant croppers, will not, when compared with some of the medium

varieties, produce crop sufficient to counterbalance the extra ground occupied. The distance they require to be planted apart, so as to give them a chance of arriving at perfection, is at least 4½ feet between the rows and 2 feet between the sets.

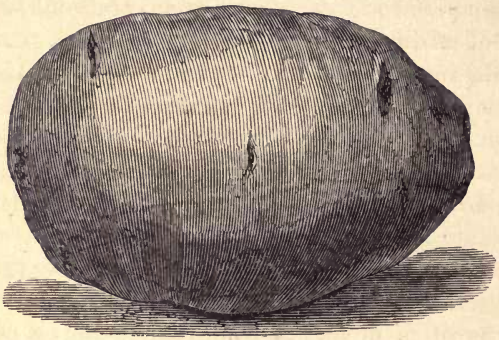

Fig. 6.—Magnum Bonum.

In gardens, as a rule, strong growing kinds of this description are seldom grown, on account of the space they occupy. Where space is limited it is an excellent plan, on good ground, to plant early and late varieties in alternate rows 2½ feet apart. The early varieties, such as Ashleafs or Early Market, are ready for lifting by the time the late kinds commence to throw out their stolons and to form their young tubers. The early varieties can be lifted without injury to their stronger neighbours, and the soil in which they have grown will serve for earthing purposes for the late kinds, while the greater space will allow room for the mass of foliage which strong kinds usually produce.

Taking, as an example, a good potato soil (fertile sandy loam), 3 to 3½ feet for medium varieties, and

2 to 2½ feet for dwarf kinds, will be found a fair distance between the drills. The space between the sets in the drills must also be regulated in accordance with the general habit of the plant and the kind of sets used. Whole tubers may be planted from 15 to 18 inches apart for dwarfs, and from 15 to 20 inches for those of medium habit.

For single-eye culture the same space between the rows as for whole tubers may be maintained, as it gives plenty of soil for earthing purposes, and allows free access to the sun and air; but from 9 to 12 inches between the eyes in the rows will be found quite sufficient.

During the past season I carried out experiments to a great extent, endeavouring to ascertain with what varieties of potatoes, and from what kind of sets, the largest crop could be produced from a given extent of land: the soil being a light loam, treated as previously described, and the sets planted in drills 3 feet wide and 2 inches deep. Four rows of each variety were planted in the following manner:—

1st row.—Whole tubers (weighing about 4 oz. each) planted 18 inches apart.
2nd row.—Sets of three eyes, planted 18 inches apart.
3rd row.—Sets of two eyes, planted 15 inches apart.
4th row.—Sets of single eyes, planted 9 inches apart.

When the crops were lifted the result without exception was found to be in favour of the single eyes. The experiment was carried to a much greater extent with Snowflake than any other variety, single eyes being planted at various distances, ranging from 6 to 18 inches apart; but the extra crop produced by the sets planted

at the greatest distance was not so great in proportion to the ground occupied as that produced by the sets planted at the lesser distance: the tubers at the greater distance being larger, but no more in number than those planted closer.

It should be borne in mind that the object of the culturist is to obtain the heaviest crop possible, of the best quality, and of the most useful size, with the least amount of labour and expense. This object, where the soil is suitable, is best attained by the single eye principle of culture, allowing plenty of room between the drills, but adjusting the eyes in the rows to such a distance as to fully occupy the ground.

As soon as the plants have made their appearance above ground, the hoe should be used freely, thus checking the growth of weeds, and breaking the crust that has formed on the top of the soil. For hoeing round the young plants it is best to use a common hoe, always taking care to draw the earth towards the stems of the plant. The space between the rows, which will have become more or less firm according to the texture of the soil, should be broken up either with a steel fork or a pronged hoe, sometimes called a *cultivator*, of which there are several kinds. The best is that represented by Fig. 7, having six prongs or tines, which are made in pairs, and can be firmly secured in the eye of the iron head by means of a wedge and a small piece of leather. The prongs are square, and eight inches in length, the outer pair being ten inches apart, which is the actual width of the hoe. When it is desirable to reduce the size, the outer prongs can be taken out, thus reducing the hoe to the width of six inches, the prongs being

again made firm in the eye by the addition of another wedge.

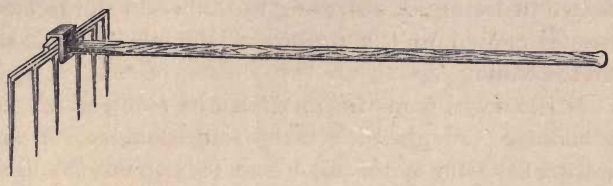

Fig. 7.

On light and medium soils this is a most useful implement for breaking up the soil, and for general earthing purposes, and a much greater amount of work can be got over with it than by digging with a fork; but for stiff, wet, or stony land, the fork is of course preferable.

If the soil be poor, and the application of artificial manure were neglected before planting, it should be at once spread between the rows, so that it can be thoroughly mixed with the soil with the fork or hoe, as the case may be; care being taken that the manure does not touch the foliage, to which it is often very injurious.

When the plants have grown about three inches high, earthing operations may be commenced by drawing the earth from the spaces between the rows up to the stems of the plant; and if the land has been tilled as previously directed, the soil will be minutely divided and free in texture, thus greatly lessening the labour, for a man can do a much larger space in a day when the land is in good tilth than he could if the soil were hard and unkindly.

Too much soil should not be placed round the

stems at one time; and it is best that the earthing or moulding up should be done at intervals of ten days or a fortnight, according as the weather is more or less favourable to the growth of the plants. At the first earthing up about two inches of soil may be drawn closely round the stems of the plant, which will encourage the plant to throw out fresh rootlets and stolons from the stem, and which it will not be backward to do under favourable circumstances. When the plants have reached the height of about six inches, more earth may be added in proportion to the strength of the variety, and as the plants grow the operation should be repeated, till the old tubers are buried to the depth of about nine inches, especial care being taken not to break or bruise the foliage while earthing.

The old rough-and-ready plan of allowing the plant to grow twelve or fifteen inches high before earthing, and then adding all the earth at one time, is bad both in theory and practice, for the plant sustains thereby a severe check, and it is no unusual thing to see plants under this treatment flagging for several days if the sun is bright and warm. The reason of this is that the resources of the plant have become limited in consequence of the injury that has been done to its source of supply, for by this time the rootlets of the plant would be spread over the entire surface in search of food, and consequently when the plants are earthed, the rootlets are cut and broken in all directions, and the foliage also coming in for its share of damage, the plant has a part of its work to do over again.

Adding the earth at brief intervals to the stems

of the plant possesses advantages which far outweigh any extra labour that it might occasion. In the first place it destroys all weeds as soon as they make their appearance, and disturbs the insect life that is often so destructive to the potato crop; it also encourages the development of rootlets and tubers from that part of the stem that has been buried by the soil, thereby invigorating the plant and augmenting its production. It is well known to those who grow potatoes for exhibition, that upon soils that have the least claim to tenacity, the cleanest and handsomest tubers are as a rule formed in the soil that has been placed round the plant by earthing; and the cause of this is obvious, for by moving the soil from time to time it becomes warm by the sun's rays, and by placing it in thin layers round the plant, the absorbent root surface is also increased, which gives the plant the greater opportunity of obtaining all the elements of food requisite for its development; for plants do not take up their inorganic constituents in solution, but by root attraction, and the more the soil becomes pulverised and friable, the better able will the roots be to ramify and search it in every part, thus bringing the spongioles of the rootlets in direct communication with the elements of the food of the plant.

CHAPTER VII.

RAISING NEW VARIETIES FROM SEED—HYBRIDISING OR CROSS-BREEDING — CULTIVATION OF SEEDLINGS — PROPAGATING BY CUTTINGS.

In raising new and improved varieties of potatoes from seed great care and patience are involved. All kinds of plants that have been improved by crossing have a tendency to degenerate, or fall back into their original state, and the potato possibly possesses this tendency to a greater degree than most plants; therefore it is almost useless to gather the seed-balls and sow the seed of varieties that have not been judiciously crossed, or hybridised, as it is usually called, for it has been calculated that not one seed in twenty thousand that have been left to chance will produce an improved variety. In endeavouring to raise improved varieties from seed the ideal potato should be firmly fixed in the mind, and the operator should have a clear conception of what he wishes to obtain, and then choose those varieties for crossing that possess the desired qualities which he wishes to concentrate in one.

Hybridisation, or, more strictly speaking in the case of the potato, cross-breeding, is in itself a very simple process. Having selected the varieties to be crossed, the seed-bearing parent first requires attention. As soon as the plant shows its flower buds

they should all be removed except those which are to be impregnated, and when the flowers open the stamens should be removed with a pair of sharp scissors, taking care not to injure the pistil. The truss of bloom should be tied to a stake, and covered over with a piece of gauze, to prevent premature fertilisation by insect agency. In about two days after the flowers have opened, if the weather be favourable, they will be in a fit state for impregnation. A flower should then be taken from the plant which is to be the father of the future seedlings, and the pollen from its anthers carefully applied to the pistil of the plant that is to be the mother, or seed-bearing parent.

The operation should be performed in fine weather, and, unless the operator is well acquainted with the process, it should be repeated the next day to ensure satisfactory results. As soon as fertilisation has taken place, which will probably be within a few hours after the pollen has been applied, the netting and stake may be removed.

It is very rare that a seedling is obtained which represents the two parents in a perfectly intermediate degree; the general habit is usually that of the mother, or seed-bearing parent, while the colour of the flowers and tubers generally resembles the male plant. Although no absolute principle can be laid down, as a rule the plant that possesses the strongest habit and constitution should be made the seed-bearing parent.

When it is desirable to cross those varieties which seldom produce seed-balls, the young tubers should be removed from the root as soon as formed, and the whole energy of the plant is then devoted to perfecting

its fruits, and by this means seed may often be obtained from varieties which, under ordinary culture, seldom bring their fruit to perfection.

The seed-balls should be gathered as soon as ripe, and the seed sown early in February in well-drained seed-pans or boxes filled with sandy loam, and placed in a little heat. When the seedlings are large enough to handle, they should be pricked out singly, and gradually hardened off, and as soon as safe from frost they should be planted out in a well-drained soil.

It usually takes three years to ascertain the true value of the seedlings. The first year they will produce tubers about the size of a walnut; the best shaped of these should be selected and carefully stored for planting the next spring, when they should be planted at the usual time, bestowing on them the same care and culture as on the general crop. The best shaped tubers should be again selected for planting the ensuing spring, and under favourable circumstances the true character of the seedlings will be then fully developed.

If the experimentalist has succeeded in obtaining an improved variety, the fourth year he would naturally wish to raise as large a crop as possible, so as to be able to place it in the market the following year. For a really good variety there is always a great demand, and a good price can be realised. The first season of Snowflake being sent out the price was twelve shillings per pound, yet the supply was not equal to the demand.

When the object is to obtain as large a quantity as possible from a given weight of seed, propagating by cuttings will be found most advantageous. We will take for example 1 lb. of potatoes, consisting of 4 tubers,

averaging 12 eyes each, making a total of 48 eyes. The eye of the potato consists of several buds, usually from two to six; and when planted in the usual way only one, or at the most two, buds start into growth, the rest lying dormant; but when the eye is subdivided into as many sets as there are buds, every germ

Fig. 8.—A Cutting of the Potato Plant, ready for insertion.

is brought into active growth. Taking as an average three buds to each eye would give 144 sets from the one pound of tubers. The sets being small should be carefully planted, early in February, in 3-inch pots, in a light rich soil, and placed in a warm frame where the temperature is about 50°, giving but little water until the

sets have commenced to grow. When the plants have reached the height of about six inches their tops (see Fig. 8) should be taken off and inserted in single pots, and then plunged in a bottom heat of about 70°, when they

Fig. 9.—The Cutting when Struck ready for Planting Out.

A—Rootlets.

B—Stolons from which the tubers are produced.

will strike freely. As soon as these cuttings have grown to a sufficient height their tops may be removed, and also

the side shoots that will have grown from the original sets, and struck in the same manner. They should be gradually hardened off and planted in the open ground, in May, in rich, well-prepared soil. By this means an immense number of plants can be raised from the one pound of tubers ready for planting out at the proper season, and at the least from three to four thousand pounds of potatoes could easily be grown from one pound of seed, by this method, in one season.

CHAPTER VIII.

THE DISEASE—OPINIONS RESPECTING ITS CAUSE—REMEDIES ADVOCATED—AMMONIA, ITS EFFECTS—GOOD CULTURE A PREVENTIVE—BEST MEANS OF SECURING THE CROP.

It is usually during the month of July that the potato disease attacks the plant, and potato-growers look with some anxiety for the first fatal spot on the foliage.

The present generation know but little of the dismay, sorrow, and suffering caused by the disease when it appeared in its most virulent form in 1845-6. Distress amongst the working classes was extreme, and the country was agitating for the repeal of those noxious corn laws that taxed the people's bread. Providence, too, seemed unkind, for the corn crops of the two previous years had been short, and the summer of 1845 was unusually sunless, wet, and cold, and therefore unfavourable for the development of vegetation.

For a few days in July the weather somewhat improved, and the hopes of the husbandman were raised thereby. It was just at this time that it was noticed that there was 'something wrong' with the potato crop, and so rapidly did the malady spread, that it was not noticed in many parts until the tops of the potatoes were quite black, and it was at first thought that they had been cut down by a frost. But in a few days the

truth broke in upon the minds of men, and a cry was heard throughout the length and breadth of the land, that a murrain was destroying the potato crop; and so great was the distress, and so unsettled were men's minds, that the leaders of the political party of that time, who had so strongly opposed the abolition of the corn laws, had to reconsider their previous decision, and to pass those very laws they had so long opposed, viz. the opening of our ports for the free admission of corn; so that this little parasite that annually makes such havoc in our potato crops, and which has baffled both the scientific and the practical world, also turned the political parties of England topsy-turvy.

But it was in Ireland that the whole force of the calamity was felt, the rural population almost entirely depending upon the potato crop for their sustenance. Father Mathew describes, in few but graphic words, the state of the country at this time. He says: 'On the 27th of July I passed from Cork to Dublin, and this doomed plant bloomed in all the luxuriance of an abundant harvest. Returning on the 3rd of August I beheld one wide waste of putrefying vegetation. In many places the wretched people were seated on the fences of their decaying gardens, wringing their hands and bewailing bitterly the destruction that had left them foodless.'

The famine that followed, the assistance sent from this country, and the exodus of a large portion of the people, are now matters of history; but, as if to verify the old proverb 'It is an ill wind that blows no one any good,' of the thousands that sought new homes in America, there are many, now owners of happy

and prosperous homesteads, who date their success in life from the stern necessity which drove them from their native land.

For more than thirty years this disease has caused great loss in our potato crops, as each year has been more or less favourable to its development, without any remedy having been discovered whereby its ravages could be stopped.

During all these years Practice had been anxiously looking to Science for information as to the nature and cause of the disease, although practical men did not neglect their own duty in the matter; and surely they have a just cause of complaint against science, for instead of throwing light on the subject, it became the more mystified, on account of the diversity of opinion amongst scientific men respecting it; for until the discovery of the resting-spores in 1876, nothing was known for certainty as to the nature of the disease.

It is true, the Rev. M. J. Berkeley believed the disease to be of fungoid origin, and put forth his views in a very able memoir; but it was not recognised as an established fact until the discovery of the resting-spores by Worthington G. Smith.

Berkeley, Lindley, Playfair, Decaisne, Graham, Phillips, Cox, Morren, and many other writers on this subject, differ widely in their opinions respecting the nature and cause of the disease.

In 1846 a book, dedicated to the late Prince Consort, was published by the late Alfred Smee, F.R.S., in which, after giving some useful information on the individuality, chemistry, and uses of the potato, he states: 'This disease in the potato is mortification or

gangrene in the truest sense of the term.' Then, after demonstrating that this gangrene may continue its ravages in any part of the plant from its leaflets to its tubers, thereby causing its destruction, he looks round for the cause of the malady, and, completely to his own satisfaction, he finds it in an aphis, the Aphis Rapæ of Curtis, which he renames '*Vastator*,' and a more formidable vastator to vegetation has never been conjured up in the mind of man, and before which the Colorado Beetle sinks into insignificance. He remarks that when these aphides have destroyed one field of plants, they fly away in a vast cloud to some new locality, there to recommence their ravages.

The constitutional-malady theory is advocated by many gentlemen whose names as potato-culturists stand high. These were led by Boyne, and followed by such men as the late Messrs. Paterson of Dundee and Eccles Haigh of Liverpool, both ardent believers and workers in this theory.

The principle they advocate as a remedy for the disease is the raising of new varieties by seed from the wild potato crossed with varieties now in cultivation, believing that, in consequence of the potato having been so greatly improved in quality and productive powers, its constitution has become weakened, and hence the disease follows as a matter of course. But they ignore the fact that the disease is known to exist in the wild varieties themselves; neither do they appear to take into consideration the thousands of seedlings that are annually raised both in this country and America.

Soon after the disease first made its appearance, an

American gentleman, Mr. Goodrich of Utica, raised many thousands of seedlings, crosses between the wild varieties and kinds then in cultivation, and it is from this stock that nearly all the new varieties were raised that have been introduced into this country from America during the last few years; and no one who has grown them can say that they are disease-proof.

Since the discovery of the resting-spores of the fungus (*Peronospora infestans*) by Worthington Smith, the belief that the fungus is the cause and not the result of the disease has become general, although not universal; for as late as January of the present year, a gentleman lecturing at Maidstone on the subject, exhibited an insect to whose ravages he attributed the disease; and Mr. S. Wood, in his lately published 'Multum-in-Parvo Gardening,' states: 'And I maintain that it (the disease) is the effect of atmospheric influences, without the shadow of a doubt.'

Innumerable remedies have been put forward as cures or preventives of the disease, but so far all have failed. When the nature of a disease is known, a remedy is usually found to counteract its influence, so that when Mr. W. G. Smith sent out his compound called 'Salus,' which was to be at once 'a fertiliser, an insecticide, and disease-preventive,' great hopes were entertained that, as he had conclusively proved the fungus to be the cause of the disease, he had also discovered a remedy whereby, at least, its ravages might be checked. 'Salus' was used by a great number of potato-growers, but, like all other nostrums that have yet been invented, it utterly failed either to prevent the disease or stop its progress.

As up to the present time neither science nor practice has discovered any remedy or preventive for this disease, we have to fall back upon experience acquired during the past; and by carefully noting the appearance and development of the malady, under the different forms and methods of culture, we must at least gain some knowledge by which we may profit in the future.

The fungus attacks the potato plant at all stages of its growth, but usually spreads with greater rapidity at that period which may be called the turn of life of the plant, that is, when the constituents collected and stored by the plant in its foliage are transformed into constituents of the tuber, there to form, as in all tuberous-rooted plants, nutriment for the next season's development; and although different varieties may be growing side by side it does not follow that they are all attacked simultaneously.

Though the potato plant often makes strong and vigorous growth in damp situations, and upon land that is badly drained, and from which large and abundant crops are sometimes obtained, the success of the crop in such situations almost entirely depends on the season. Should the weather be dry and warm at that period when the plant is most susceptible to attack (thus allowing it to perfect its growth, and ripen its tubers) all is well; but should the weather prove the reverse, the chances are that the crop will be entirely destroyed, for such positions appear to be the very home of the disease.

Of all the elementary constituents that form a portion of the food of the potato plant, ammonia appears to hold the most conspicuous position with respect to the attack and spread of the fungus; in fact, com-

bined with moisture, it appears to be the one thing absolutely necessary for its development.

Nothing has been more conclusively proved by practice upon this point, than that manures which contain a large amount of ammonia, and nitrogenous matter, accelerate the attack of the disease, and promote its destructive properties. Crops that have been manured with raw or fresh farmyard dung, night-soil, guano, or any fresh animal substances that are rich in ammonia, are always the first to be attacked, and suffer most, the entire crop being often destroyed.

Its destructive properties are often most conspicuous immediately after a thunder-storm (it was at one time the popular belief that the disease was caused by the electricity in the air), particularly if the weather previously has been hot and dry. The action of the ammonia contained in the manure has become limited by the lack of moisture; but immediately the moisture has been supplied by the rain, decomposition of the manure is carried on with greater rapidity, the ammonia is set free, and passes into the air by evaporation. The plant is consequently surrounded by a warm humid atmosphere which contains ammonia in excess.

By examining a leaf of the potato plant, it will be seen that its breathing pores are situated principally on its under surface, well adapting it for absorbing the gaseous elements as they arise from the soil.

The parasite always attacks the plant on the under side of the leaves, 'never,' says Mr. W. G. Smith, 'appearing on the upper surface, which is impervious to its attacks. . . . . The whole of the leaves' mouths, or breathing-pores, soon become completely choked up.

. . . . The fungus stems protrude from its mouths, and prevent the emission of perspiration; the potato plant thus gets surcharged with moisture, which rots the stems and leaves, whilst the mycelium preys upon the tissues.'

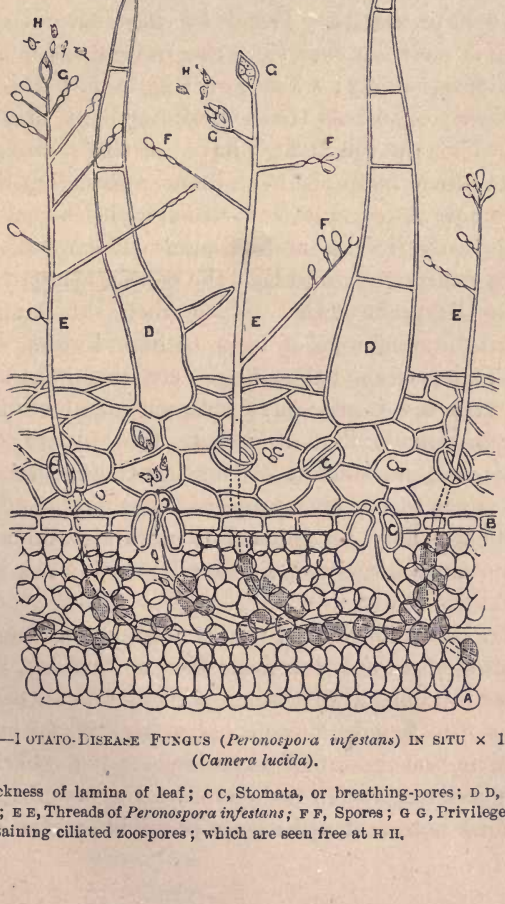

Fig. 10.—Potato-Disease Fungus (*Peronospora infestans*) in situ × 150 diam. (*Camera lucida*).

A A, thickness of lamina of leaf; C C, Stomata, or breathing-pores; D D, Hairs on leaf; E E, Threads of *Peronospora infestans;* F F, Spores; G G, Privileged spores, containing ciliated zoospores; which are seen free at H H.

When the plant is attacked by the fungus the mycelial threads spread rapidly through the whole plant, passing down the stems into the tubers in an incredibly short space of time, its progress being no doubt accelerated by the attractive or absorbent powers of the tubers at this special period of their growth.

We have therefore learnt by experience that the disease is most destructive to the potato under certain conditions, namely: when growing in low and moist situations; upon land that is undrained; in shady positions, where the sun and air have not free access; upon soils to which manures have been applied that contain a large amount of ammonia, which causes a rank, gross growth in the haulm and foliage, rendering it an easy prey to the fungus; and that the disease is usually most fatal to the plant at that period when the foliage has reached the maximum of its growth, and what is called the ripening of the tubers is just commencing, at which time they are most active collecting and storing up the constituents that constitute the quality of the potato; and practical experience has likewise taught us under what theory and mode of culture the effects of the disease may be reduced to a minimum, and by what means a large crop of sound potatoes can be produced.

Mr. Peter McKinlay, who is well known as one of the most successful potato-growers of the day, writing in the 'Gardener's Magazine,' states: 'As for disease I have ceased to calculate on its occurrence, for long observation and practical experience have taught me that good cultivation is an effectual preventive, for in the worst seasons it will ensure profitable crops.'

As we cannot always choose the situation and soil in which we intend to grow our crops, we must to a certain extent be governed by circumstances, and adapt our practice thereto. If the soil upon which potatoes are to be grown is light, or free, and well-drained, we possess the first thing requisite for the well-being of the plant; everything else, season excepted, depends upon our method of culture. Where the soil is poor or deficient of those inorganic constituents of which the plant is composed, they must be supplied by manuring.

But, it may be asked, what is a poor soil? A soil is either rich or poor, according as it possesses the necessary properties to bring to maturity the particular plant that is to be grown upon it, and the term 'manuring' means, supplying those constituents of which that plant is composed.

It is not the requisite constituents of the plant, present in the soil, that promote the attack and spread of the disease, but the superfluous elementary substances that may have been supplied under the name of manure, which, by over-stimulating the plant, cause it to grow away from its natural habit. The haulm and foliage consequently become coarse and rank, the supply of woody fibre is small, the cells of the plant are large and their walls weak, and the plant is in a state of natural debility, caused by an excess of stimulating matter, and hence it becomes an easy prey to the fungus.

I have elsewhere stated the kinds of manure and the method of applying them that are most likely to ensure a good crop of tubers, and also by what mechanical means the soil is best prepared, and I only allude

to the subject here in reference to its bearing on the disease.

That the potato crop depends to a great extent upon the state of the weather is beyond doubt. Should it prove dry and warm during June and July, the early and second early varieties would probably escape, or only suffer to a very limited extent, except in unfavourable situations. But when heavy rains or thunderstorms prevail at that season, the potato is sure to suffer more or less from the disease in most situations.

We gather from Mr. Carruthers' able report of the disease-proof potato competition, instituted by the Royal Agricultural Society of England in 1874, that the potato crops suffered more severely from the disease in Ireland, and on the western side of Great Britain than on the eastern side, owing to the rainfall being far greater in the former localities than in the latter; and also that the plant was comparatively free from disease upon soils naturally or artificially well drained, and where no strong stimulating manures had been used.

Next it has to be considered which varieties are most able to resist the disease, and what are the best means of saving the crop, when they are once attacked. Late kinds usually suffer to a far greater extent than early or second early varieties, on account of their not ripening their tubers before the autumnal rains set in. Early varieties, as a rule, are not large croppers, but they generally escape the disease if planted early, and lifted as soon as they are ripe. Of second earlies, there is a great number of varieties, and amongst them are found some of the finest kinds and heaviest croppers in

cultivation; many of them being also good keepers. Of these Snowflake may be taken as a specimen. It is at the present time, when well cultivated, the finest potato grown, and is fit for use ten months in the year, namely, from August to May. Like most of

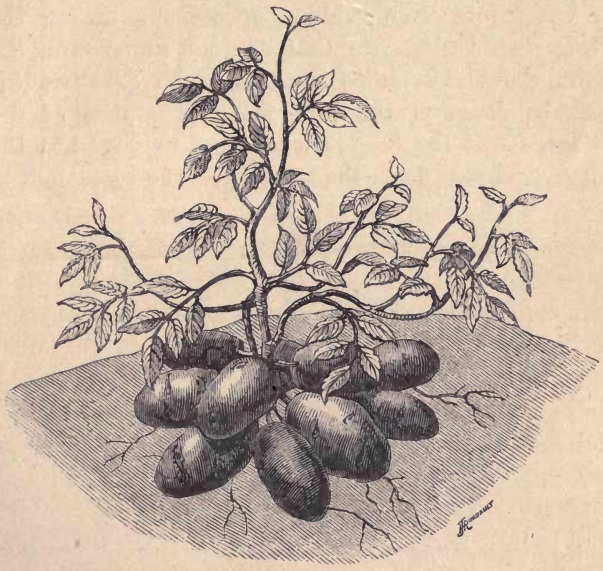

Fig. 11.—SNOWFLAKE. Showing its habit of growth from a single eye.

the American varieties, it possesses the qualities of very rapid growth, and early development of the young tubers, so that by the time the disease makes its appearance (usually about the middle of July) they will have reached their full growth, and it is our own fault if they are allowed to rot, for though we cannot cure

the disease, we can, to a great extent, control its effects.

As soon as it is perceived that the fungus has attacked the foliage of the plants, those varieties that are nearest maturity should be immediately lifted; that is, providing the skin of the tubers is firm enough to prevent injury from rubbing or bruising during the lifting. Of those sorts that are not so forward, the haulm should be pulled up, and, to be effective, this must be done on the very first appearance of the disease, for if the fungus is allowed to spread in the foliage, and pass down the stems into the roots, it is of

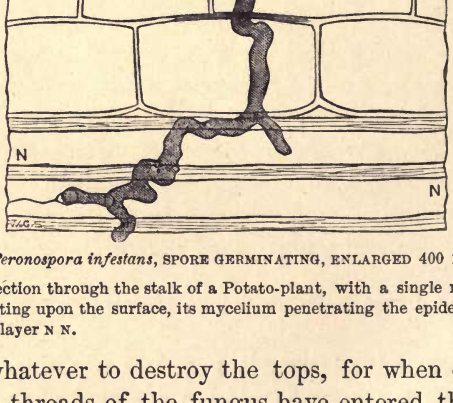

Fig. 12.—*Peronospora infestans*, SPORE GERMINATING, ENLARGED 400 DIAMETERS.

Showing a section through the stalk of a Potato-plant, with a single mature spore germinating upon the surface, its mycelium penetrating the epidermis M, and cortical layer N N.

no use whatever to destroy the tops, for when once the mycelial threads of the fungus have entered the tuber, its destruction is certain. Though the presence of the fungus may not be apparent when the potato is lifted, in a short time it will spread through the cells of the tuber, which will speedily become useless.

When once the parasite has attacked the plant, there are no means of saving the crop but by lifting the tubers or destroying the haulm before the fungus reaches the tubers. I cannot too strongly urge the adoption of this principle, having proved its efficacy for the past twelve years. During that time I have grown every potato of any note in cultivation, under all the principal methods of culture usually adopted. I have also tried, with more or less success, most of the remedies advocated by both scientific and practical men as palliatives or cures of the disease; and the system that I have found most successful in producing a sound and remunerative crop, is, planting principally second early varieties, and lifting the tubers, or destroying the haulm, immediately the disease makes its appearance.

I am certain that if this principle were more generally carried out, we should not hear of so many crops being partially or entirely destroyed by the disease, and many of the thousands of tons of tubers that are annually wasted would be available as food, and a large amount of money that is now lost would pass into the pockets of the growers.

CHAPTER IX.

STORING—KEEPING SEED TUBERS DURING WINTER—CHANGE OF SEED—STORING LATE VARIETIES—CLAMPING.

When the crops are lifted they should be laid in a dry place and allowed to remain for some time before they are finally stored for the winter; a little straw or litter of any kind thrown over them will exclude light and air, while allowing the moisture to escape. In about a month they should be moved and carefully looked over, by which time the disease will have shown itself in any of the tubers that were touched by it before lifting.

This would be the best time to select the seed for planting the following spring. For whole sets, the tubers should be selected of as even a size as possible, each weighing from three to four ounces. For the single eye principle, large and well-shaped tubers should be chosen, bearing in mind that with single eyes a much smaller quantity of seed will suffice to plant an equal extent of ground than if whole tubers were planted, and this is often of importance where stowage room is limited.

A successful crop depends to a great extent upon the care bestowed on the seed tubers, and the way in which they have been kept during the winter months. If the eyes are allowed to start into premature growth

(thereby losing a part of their vitality by too early development) they will have lost the first principle that encourages a quick and vigorous growth.

The tubers should be placed in such a position that they can be turned over from time to time, and the air allowed to circulate amongst them, which will harden the eyes, and prevent them from starting into growth too early. In early spring, when the eyes have commenced to grow, every care should be taken that the young shoots are not injured, for the crop is never so early nor abundant from sets of which the first growth of the eyes has been destroyed.

One of the best plans for keeping the seed tubers in good condition is to store them in a well-ventilated cellar or room, where they will be perfectly safe from frost, and in which as equal a temperature as possible of about 45° can be maintained. A small cellar or room can be made to hold a large quantity of seed, by having thin open shelves arranged round the walls, three feet wide, and about fifteen inches apart, one above another, upon which the tubers should be thinly spread; always keeping the varieties separate. In mild weather the ventilators should be opened, so as to allow a free circulation of air, which will cause the first growth of the eyes to be thick and sturdy, and not easily broken off from the tubers.

If the seed tubers have been well kept, by the time of planting the eyes of the early varieties will have started about half an inch, the sprouts being nearly as thick as one's finger. Small rootlets will have commenced to form at the base, only waiting to be brought into contact with the soil to start into active growth.

Change of seed is advocated by many, both as a partial remedy for the disease, and as being beneficial to the general crop. It is supposed that seed that has been grown in a totally different locality and soil, will produce a heavier crop than seed that has been grown in the same soil for several years.

It is difficult to see upon what principle this theory can be advocated, or what extraordinary influences are brought to bear upon the germ of the eye of a potato that, having been grown upon, say, a chalky soil, is the following season transferred to a vegetable mould; seeing that the constituents of the tuber serve only to sustain the growth of the eye until the young plant is capable of taking up and assimilating nutritious matter for itself; that is, as soon as the foliage of the plant has penetrated into the atmosphere, when assimilation immediately commences.

However well the principle of change of seed may sound in theory, when reduced to practice it is, I think, impossible to be substantiated. That a change of seed is desirable when the plant has been badly cultivated, and the tubers still worse kept during the winter, is beyond doubt, for the simple reason that the constitution of the plant has become impaired by bad culture.

A few years ago I had a firm belief in the efficacy of change of seed, but I have learnt from practical experience that abundant crops of sound tubers can be grown from the self-saved seed for years, if only the plant is well cultivated, and a little care is exercised in the selection and keeping of the seed.

I grow all the principal American varieties that

have been introduced into this country during the past fifteen years. My present stock is the produce of one pound of seed of each kind, bought the first year they were sent out, and I have no hesitation in saying that instead of degenerating they have most certainly improved. Their vigorous constitutions are not impaired, and they crop as heavily as the first year after they were sent across the Atlantic. The quality of the tubers is also improved, the flesh being finer grained and softer to the palate, equalling the best of our English varieties in flavour while far surpassing them in cropping qualities.

The cooking qualities of late varieties of potatoes are greatly influenced by the manner in which they are kept during the winter months. If they are stored in damp positions, or in large earth clamps, and allowed to lie too long without being moved, the eyes start into growth, and producing shoots several inches long, ultimately become matted together with their own growth. Potatoes that have passed through this ordeal lose both their quality and flavour, and are consequently unfit for cooking purposes and useless for seed.

Potatoes should be stored in a dry situation, where a low and even temperature can be maintained. Cellars or sheds are excellent for this purpose, as the potatoes are then accessible at all times, and the operation of turning and looking them over can be performed when the weather is unfavourable for out-door occupations.

When stowage room is limited and out-door clamping has to be resorted to, the north side of a wall or any building is a good situation for making the clamp. The north side is preferable to any other on account of

the absence of sun, which renders the temperature lower and also more equal. Coal ashes should be spread over the ground to the depth of from four to six inches. These will absorb the moisture arising from the soil, and form a dry bed, on which the potatoes should be laid, heaping the latter against the wall, which will thus form one side of the clamp. If the wall is not of sufficient thickness to exclude frost, a good layer of straw should be placed between the wall and the tubers.

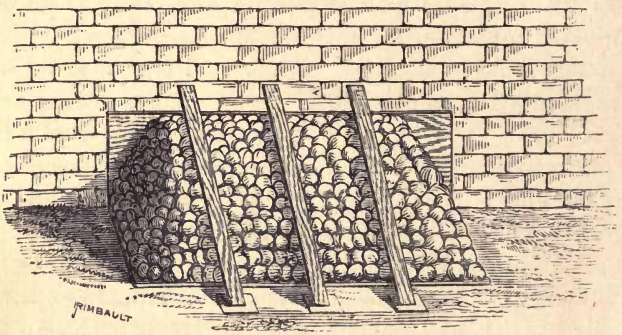

Fig. 13.—Potatoes Clamped ready for Covering.

A covering, at once simple and effectual, can be made with only a few feather-edged weather boards, and some pieces of wood, say three, to answer as rafters for the boards to rest on. One end of each rafter should be placed against the wall, above the potatoes, the other resting upon a brick placed on the ground beyond the clamp. The boards should then be nailed on the rafters, beginning at the bottom and working upwards, the top board being let into a joint of the wall about a quarter of an inch to carry off the

water that would otherwise run down the wall into the clamp. This covering, while being perfectly waterproof, is removable at pleasure, and when not in use it can be easily taken to pieces and put away in a very small space.

If the tubers are not dry at the time of clamping they should be lightly covered with litter, and the boards placed over them, the ends being left open to allow a free circulation of air. This would also give the opportunity of looking over the potatoes, before finally covering them up for the winter, to make sure that no diseased tubers had been stored amongst them.

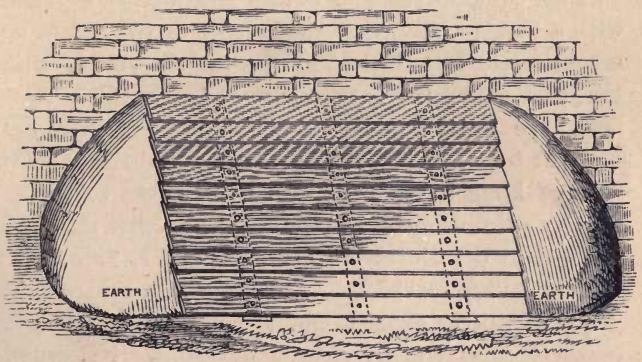

Fig. 14.—THE CLAMP WHEN FINALLY COVERED.

When finally covering in the clamp a thick layer of straw, hay, or bracken should be placed immediately on the potatoes. On this, soil or dry ashes should be spread about four inches thick, and the boards placed over all. During very severe weather the ends should be blocked with litter, and covered with earth.

CHAPTER X.

EXHIBITING POTATOES—INTERNATIONAL EXHIBITIONS—NUMBER OF VARIETIES SHOWN IN 1876—VARIETIES SHOWN IN FIRST PRIZE COLLECTIONS IN 1878—JUDGING POTATOES—SELECTING TUBERS FOR EXHIBITION—PACKING—ARRANGEMENT OF COLLECTIONS—SPECIMEN COLLECTIONS—LIST OF VARIETIES SHOWN AT THE INTERNATIONAL EXHIBITION OF 1878—SELECTED VARIETIES.

THE annual International Potato Exhibitions, organised with a view to improving the culture of the potato and favouring the introduction of new varieties, have, during the past four years, been most successful. Never before in the history of the potato had there been brought together so great a number of dishes and variety of kinds of such high quality as were to be seen at the exhibitions held at the Alexandra Palace in 1875–6, at the Royal Aquarium in 1877, and at the Crystal Palace in 1878.

The impetus given to potato culture by the holding of these exhibitions has been universal. Not only in those who exhibit their products has the spirit of improved culture been stimulated, but also in the general public who visited those shows from all parts of the United Kingdom, and there saw, many for the first time, what splendid results could be achieved, and what beauty of form and symmetry of shape the potato-tubers are capable of assuming when brought under first-class cultivation.

That these exhibitions have also been the means of introducing a great number of new varieties is evident from the increasing number of new kinds that are now sent out year by year, and by the ready sale and high prices they realise. For an improved variety the de-

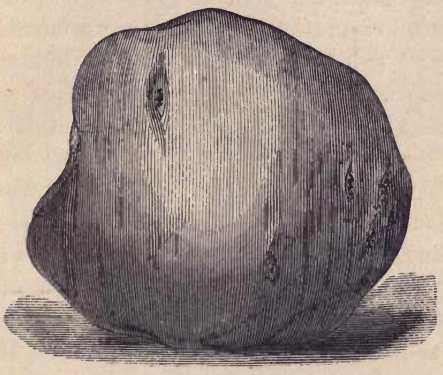

Fig. 15.—MANHATTAN. Introduced 1878.

mand is sure to be great, so that it soon becomes distributed throughout the country, to the pecuniary advantage of the raiser, who has, moreover, the satisfaction of knowing that he has conferred a benefit upon the public at large, and more especially upon the masses of the working classes.

That the International Potato Exhibitions have done a vast amount of good by encouraging the best methods of culture and the introduction of improved varieties is indisputable; but it is likewise true that they have also been the means of introducing a number of varieties whose only recommendation is that they possess a handsome appearance, and are therefore,

according to the present system of judging potatoes, desirable for the exhibition table. If these exhibitions are to continue and increase in usefulness, and to be raised above the mere repetition of an annual display of so many hundred dishes of potatoes, means must be devised whereby the general growers can obtain some information respecting the habit and productiveness of the several exhibits. It does not necessarily follow, because a certain variety of potato has been awarded the highest honours at the show, that it is a good or desirable kind to grow for general purposes; but it shows that it is a variety of good appearance, and of a size that meets the approbation of the judges for the time being, and is therefore no criterion as to its quality and productiveness. A good illustration of this was given at the show of 1876, when Red Emperor took the lead of the English varieties, and again, in 1878, when International held the premier place. These, while being respectively the handsomest red round, and white kidney, grown, are quite second-rate in quality.

At the International Potato Show of 1876 there were exhibited 1,767 dishes, not including several hundred dishes not for competition. English varieties were represented by 1,076 dishes, comprising 204 named sorts and 30 unnamed seedlings. Of these Red Emperor headed the list with 52 samples, followed by Model, Paterson's Victoria, Porter's Excelsior, and Rector of Woodstock, with 47, 46, 45, and 44 dishes respectively. Of American kinds there were 668 dishes, including 34 varieties. Snowflake was represented by nearly double the number of dishes of any other variety shown, there being no less than 104 samples, and as it maintained this supre-

macy in 1877–8, it would seem to indicate that in public opinion it stands at the head of all varieties for exhibition. Of four other American sorts, more than fifty samples of each were shown; these were Brownell's Beauty, Early Vermont, Redskin Flourball, and Bresee's Prolific.

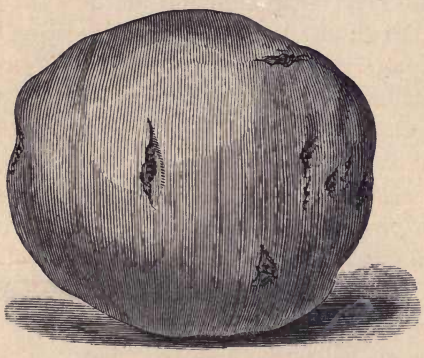

Fig. 16.—Brownell's Beauty.

Although at the International Potato Exhibition of the present year (1878), which was held in conjunction with the Great Autumnal Fruit Show at the Crystal Palace, the number of dishes and varieties of potatoes shown was not so great as in some previous years, the cause is in nowise attributable to lack of interest being taken in the show by potato-growers generally, but rather to the fact that growers have found that many of the varieties they had believed to be amongst the best in cultivation could not stand the test when placed by the side of newer kinds. Hence we find that no less than 80 varieties that were shown in 1876 have entirely disappeared from the exhibition table, and

many other of the older kinds nearly so, and in all probability in a year or two they will also have passed away, giving place to the new and improved kinds that are being annually introduced. During the past two years no less than 40 new English, and 13 American varieties, have been added to our list of exhibition potatoes.

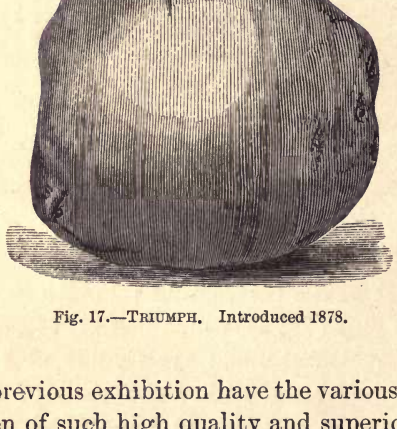

Fig. 17.—TRIUMPH. Introduced 1878.

At no previous exhibition have the various collections staged been of such high quality and superior style, nor the competition so keen, as at this show, there being scarcely a bad dish placed on the tables, many of the collections being of such nearly equal merit in every respect as to give the judges some difficulty in making the awards.

The following are the varieties shown in the collections that took the first prizes in the principal classes :—

CLASS A. 24 *Varieties.*

Ashtop Fluke
Beauty of Hebron
Beckenham Beauty
Blanchard
Brownell's Superior
Cambridgeshire Kidney
Carter's Breadfruit
Early King
Early Vermont
Edgcott Seedling
Grampian
International Kidney
King of Potatoes
Lady Webster
Late Rose
Onwards
Porter's Excelsior
Rector of Woodstock
Red Emperor
Schoolmaster
Shelburne
Snowflake
Trophy
Woodstock Kidney

CLASS B. 18 *Varieties.*

Beauty of Hebron
Bresee's Peerless
Brownell's Superior
Burbank's Seedling
Carter's Breadfruit
Coldstream
Covent Garden Perfection
Early Goodrich
Early King
International Kidney
Lady Webster
Magnum Bonum
Manhattan
Norfolk Giant
Redskin Flourball
Schoolmaster
Snowflake
Vermont Beauty

CLASS C. 12 *Varieties* (English).

Lapstone
Magnum Bonum
Princess of Wales
Rector of Woodstock
Red Fluke
Red Regent
Royal Ashleaf
Salmon Kidney
Schoolmaster
Scotch Blue
Walnut Leaf Kidney
Wonderful Red Kidney

CLASS D. 9 *Varieties* (American).

Beauty of Hebron
Bresee's Peerless
Bresee's Prolific
Brownell's Beauty
Brownell's Superior
Early Goodrich
Early Vermont
Snowflake
Trophy

CLASS G. 6 *Varieties* (New).

Beauty of Hebron
Beauty of Kent
Early King
Manhattan
Triumph
Trophy

At the present time, when so many new and improved varieties are being annually introduced, judging

potatoes is a subject that requires a wide extent of practical knowledge. A judge should not only know what a good potato is, but he should also have a practical knowledge of at least all the principal kinds in cultivation, and be well acquainted with their habit of growth, productive powers, and the table qualities of the tubers.

The principle by which potatoes are usually judged is by a standard of nine points, thus: three points for size, three for shape, and three for appearance and quality, ignoring entirely the productive powers, which should be one of the first considerations, for no matter how handsome in shape and appearance the tubers may be, if the variety is of a weak constitution, and its tubers are but sparingly produced, it can only be considered a second-rate kind.

With the addition of such a large number of new varieties to the list of those already in cultivation, the standard by which potatoes are judged should be raised to such a position, that not only size, shape, and quality be taken into consideration by the judges, but also the general habit and productive powers of each variety. This could be done by raising the number of points to *ten*, and dividing them in the following manner:—Two points to size, two to quality, two to shape, two to habit, and two to productive powers; and the points would be disposed of as follows. To begin with size, a potato is either small, medium, full-sized, large, or very large. To samples considered under-sized, no point should be given; to medium samples one point; to full-sized, i.e. the size at which each variety is at its best, two points; to large samples, that is, when the

tubers approach to coarseness, one point; and to very large and coarse samples no point should be given, as they are of no more value than small potatoes, being useless except to the baker, or for feeding cattle. In the case of quality, a potato is either good, bad, or of second-rate quality, and the points would be disposed of accordingly: bad, no point; second-rate, one point; good, two points; and the same rule of judging would apply to shape, habit, and productiveness.

If this standard of judging were adopted, many of what may be called the 'ornamental' varieties—having little to recommend them except their attractive appearance—would gradually pass out of cultivation, and the awarding of the prizes would then be a guide to the general cultivator, as only those kinds that are useful as well as ornamental would occupy the most prominent positions.

Amongst the immense number of varieties of the potato grown at the present day, there are to be found varieties of all shades of character—good, bad, and indifferent. There is also a large class that may well be called 'fancy kinds': kinds that produce tubers of handsome shape and appearance, and of first-class quality, but the tubers are so sparingly produced, or of so small a size, as to make them unprofitable to grow, and of little value except to the epicure. These are well represented by Bountiful. Another class of potato produces abundant crops of handsome tubers, but of such inferior quality as to render them useless for general purposes. Of these the Blanchard is a good type.

Growing potatoes solely for show purposes, and using special means for their production, is a most objection-

able practice, and one that defeats the very end and aim of these exhibitions, which is to elevate the general character of the potato, and to encourage the production of first-class tubers under such forms and methods of culture as can be carried out by all growers. The object of the culturist should be, to obtain as heavy a crop as possible of such a quality that tubers could be selected capable of holding their own at any exhibition table.

Potato-tubers for exhibition should be of as even a size as possible, and fairly represent the variety to

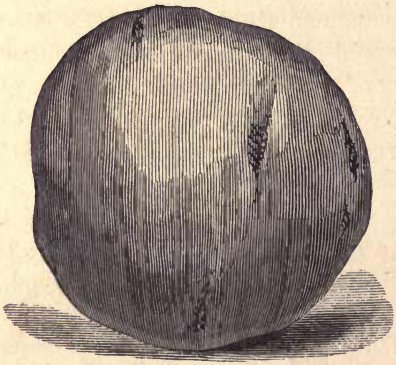

Fig. 18.—SCHOOLMASTER.

which they belong. They should be of an even and symmetrical shape, clear-skinned, free from blotches, eyes shallow, and if a smooth variety the skins should be bright and clear. Rough-skinned kinds, of which Schoolmaster is a good type, should be shown in a good clean condition, but no endeavour should be made to give it a smooth appearance: for a rough-coated variety with a smooth skin is just as much out of place upon

the exhibition table as a smooth variety shown with a rough skin, which would in all probability be passed over by the judges.

No absolute rule can be laid down respecting the size of the samples, which should vary in accordance with the average size of the variety they represent. Taking Rector of Woodstock as an example, the average size of which is 6 ounces, each tuber should weigh not less than 5½ ounces, for any tubers below that weight would be considered of small size, and would therefore lose a point in judging; and tubers of this variety that much exceed 7 ounces approach to coarseness. It is the case with all varieties that tubers that are beyond the average size of the variety they represent have a tendency to become coarse, and are therefore defective in quality. The average size of the Early Rose and Early Vermont

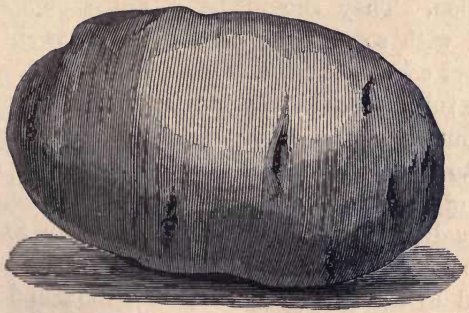

Fig. 19.—Early Rose.

is about 8 ounces, Snowflake 9 ounces, Brownell's Beauty 10 ounces, and Red Skin Flourball is at its best from 10 to 12 ounces; anything exceeding that size may

be considered too large for general purposes, and accordingly out of place on the exhibition table.

In lifting the potatoes from which it is intended to select the show tubers, great care should be taken not to bruise or otherwise injure the tubers, for no matter how perfect they may be in shape and quality, the slightest abrasion of the skin will detract from their natural brightness, and would consequently be the means of their losing one point when brought before the judges. The show tubers should be selected at the time of lifting, and on no account should they be allowed to remain on the ground for several hours in the hot sun, especially the more tender varieties. More tubers than the actual number required should be picked out to select from when packing for exhibition; for instance, if two dishes are required, it would be necessary to reserve sufficient for three, and so on in proportion. They should be stored separately, and covered with some light material, such as sifted leaf-mould, or cocoa-nut fibre.

The tubers should be shown in their natural state, clean, but free from all artificial means sometimes resorted to for the purpose of improving their appearance. A dish of potatoes that have been polished deserves to be disqualified by the judges, just as much as a stand of roses or dahlias that have had a few extra petals inserted by means of a pair of tweezers and a little gum: a practice which is sometimes resorted to by unscrupulous exhibitors.

Packing the tubers for travelling must also be carefully attended to, or all the previous care bestowed upon them will be thrown away. Boxes are most

suitable for packing in, by reason of their being firmer, of a smoother surface, and not so liable to injure the tubers as hampers.

Moss or soft hay should be laid in the bottom of the box, and a little placed between the sides and the tubers, as the packing proceeds, to keep them from rubbing. Each tuber being wrapped in a piece of soft paper, the first tuber should be placed in the left corner of the box, packing them in rows, working from left to right. Each dish of nine or twelve tubers, as the case may be, should be placed in succession, until the box is full, or all are packed.

By following this plan no difficulty or confusion will be experienced at the time of unpacking, when, reversing the order of packing, the last tuber placed in the box should be taken out first, continuing from right to left, counting the number of tubers comprising each dish as they are taken out, when it is almost impossible to make a mistake.

The tubers should be carefully arranged in the plates, so as to show them to the best advantage, and in cases of collections, the largest samples should be placed at the back, the smallest in the front row, with the intermediate sizes between, no two varieties that in the least resemble each other being placed in close proximity.

In making up a collection of six, twelve, or twenty-four dishes of potatoes for exhibition, the various types of tubers should be widely represented, and no two varieties that closely resemble each other should be shown in the same collection. Each variety should be as distinct from its fellows as possible, and the

smaller the collection the more distinct the samples should be.

A collection of six dishes should consist of one dish of each of the following types :—

White Round,	represented by	Schoolmaster.
Coloured Round	„	„ Red Emperor.
White Kidney	„	„ Ashtop Fluke.
Coloured Kidney	„	„ Garibaldi.
White Flat Kidney	„	„ Snowflake.
Particoloured Round	„	„ Grampian.

For twelve dishes the following varieties would make a good collection :—

White Round	*White Kidney*
Porter's Excelsior	International Kidney
Carter's Breadfruit	Snowflake
Schoolmaster	Ashtop Fluke
Coloured Round	*Coloured Kidney*
Red Emperor	Early Vermont
Beauty of Kent	Garibaldi
Grampian	Trophy

For twenty-four dishes the following twelve varieties may be added to the preceding, when the collection would be composed of six dishes of each type :—

White Round	*White Kidney*
Model	Woodstock Kidney
Early Goodrich	Early Giant King
Rector of Woodstock	Magnum Bonum
Coloured Round	*Coloured Kidney*
Triumph	Beauty of Hebron
Brownell's Beauty	Salmon Kidney
Scotch Blue	Superior

The following collection for twelve dishes consists exclusively of American kinds, all being second earlies, except Superior, and Brownell's Beauty :—

Beauty of Hebron
Bresee's Peerless
Bresee's Prolific
Brownell's Beauty
Early Goodrich
Early Oneida
Early Vermont
Manhattan
Triumph
Trophy
Snowflake
Superior

The annexed is an alphabetical list of the varieties, and number of dishes of each kind, shown for competition at the Fourth International Potato Exhibition held at the Crystal Palace on the 24th and 25th of September, 1878. Of English varieties there were exhibited 1,039 dishes, comprising 131 varieties; American kinds were represented by 500 dishes, consisting of 37 varieties—making an aggregate of 1,539 dishes, and 168 varieties.

ENGLISH VARIETIES.

Name	No. of dishes	Name	No. of dishes
Ashleaf, Myatt's	17	Cattell's Reliance	1
„ Old	6	Cambridge Kidney	3
„ Royal	15	Chalmore King	1
„ Purple	14	Champion Round	1
„ Red	2	Coldstream	5
„ Veitch's	3	Countess	1
Ashtop Fluke	15	Covent Garden Perfection	31
Beaconsfield Kidney	3	Cricket Ball	2
Beauty of Kent	1	Crimson Walnut Leaf	3
Beckenham Beauty	1	Dalmahoy	1
Bedfont Prolific	2	Drummond's Early Round	1
Berkshire Favourite	1	Dunmore Seedling	2
„ Kidney	2	Early Ball	1
Birmingham Prizetaker	5	„ Don	1
Blanchard	3	„ Favourite	3
Blenheim Kidney	1	„ Giant King	2
Blue Fluke	3	„ Hammersmith	6
„ Prince	1	„ Handsworth	3
Bountiful	16	„ King	26
Bryanston Kidney	3	„ Market	2

Name	No. of dishes
Early Oxford	1
„ Shaw	1
„ White Kidney	2
Edgcott Seedling	6
Emerton's Advance	2
Endin's Prolific	1
English Rose	1
Exhibition Kidney	1
Fluke	3
Fortyfold	1
Fox's Improved	5
Garibaldi	24
Giant King	12
Gloucestershire Kidney	4
Golden Eagle	2
Grampian	59
Handsworth's Superior	1
Hanwell Superior	1
Heather Bell	1
Henderson's Prolific	4
Ice Cream	3
Improved Red Round	1
„ Regent	1
International Kidney	67
Jackson's Kidney	1
Jersey Blue	2
King of Potatoes	10
„ „ the Flukes	1
Lady Eamon	1
„ Paget	3
„ Webster	6
Lapstone	16
Lemon Kidney	2
Loudon	1
Lye's Favourite	25
Magnum Bonum	62
Main Crop	6
McKinlay's Pride	9
Model	32
Mona's Pride	3
Napoleon	1
Norfolk Giant	1
Onwards	2
Oxfordshire Kidney	2
Paterson's Purple	1
„ Victoria	25
Perfection Kidney	3
Pink-eyed Kidney	1
Porter's Excelsior	40
Premier	3
Prince Arthur	7
Prince of Wales	4
Princess of Wales	2
Purple Blush	3
Purple Kidney	2
Queen of Flukes	1
Racehorse	1
Radstock Beauty	8
Rector of Woodstock	34
Red Emperor	48
„ Fluke	10
„ Kidney	1
„ Regent	3
„ Skin Flourball	18
Rinton's Coloured Don	1
Robson's Challenge	2
Rose of Sharon	1
Rosy Belle	1
Salmon Kidney	14
Scammell's Glory	8
Scarlet Prolific	1
Schoolmaster	70
Scotch Blue	23
Skerry Blue	1
Stella	1
Turner's Union	1
Vicar of Broomfield	1
„ „ Laleham	4
Victoria	3
Walnut Leaf Kidney	6
Warner's King	1
Waterloo Kidney	6
Webb's Imperial	2
„ Surprise	3
White Emperor	6
Wiltshire Kidney	1
Wonder	1
Wonderful Red Kidney	10
Woodstock Kidney	2
York Regent	3
Yorkshire Hero	10
Dishes unnamed	2
Seedlings unnamed	8

AMERICAN VARIETIES.

Name	No. of dishes	Name	No. of dishes
Abraham Lincoln	1	Eureka	2
Albany Kidney	1	Hundredfold Fluke	5
Alpha	8	Improved Peachblow	4
Beauty of Hebron	16	Idaho Snowball	2
Bresee's Peerless	16	King of the Earlies	7
„ Prolific	31	Late Rose	22
Brownell's Beauty	32	Manhattan	10
„ Superior	23	Mohawk	2
Burbank's Seedling	8	Oneida	4
Carter's Breadfruit	23	Paragon	2
Centennial	15	Peachblow	4
Climax	16	Red Peerless	2
Compton's Surprise	4	Ruby	15
Early Dimmisk	2	Shelburne	3
„ Gem	2	Snowflake	73
„ Goodrich	17	Triumph	27
„ Ohio	2	Trophy	41
„ Rose	30	Willard	2
„ Vermont	26		

There are at the present time about six hundred named varieties of the potato in cultivation, many of them being merely synonyms of the typical kinds. Some varieties, when grown in different soils and localities, vary slightly in the appearance of their tubers, hence they get re-named, and, as is often the case, the same kind is then shown under various names: for instance, Red Emperor is well known by its synonym—Main Crop.

The following fifty varieties have been selected as comprising the best and most useful kinds in cultivation; they are heavy croppers, and of good quality, and amongst them will be found varieties suitable for all soils and situations. In speaking of their quality and productive powers I judge them from the results of my method of culture as detailed in the preceding pages.

Early.

Ashleaf Royal	W. K.	med.
Early Market	W. R.	df.
Gloucestershire Kidney	W. K.	med.
Myatt's Prolific	W. K.	„

Second Early.

Beauty of Hebron	C. K.	df.
„ „ Kent	C. R.	med.
Bresee's Prolific	W. F. R.	„
Climax	W. R.	„
Coldstream	W. F. R.	„
Covent Garden Perfection	W. K.	„
Early Giant King	W. R.	„
„ Goodrich	W. R.	„
„ Oneida	C. R.	„
„ Rose	C. K.	„
„ Vermont	C. K.	„
Garibaldi	C. K.	„
Jackson's Kidney.	W. K.	„
King of Potatoes.	W. R.	„
Manhattan	C. F. R.	„
Porter's Excelsior	W. R.	„
Rector of Woodstock	W. R.	„
Ruby	C. K.	df.
Snowflake	W. F. K.	med.
Triumph	C. R.	„
Waterloo Kidney	W. K.	„
White Emperor	W. R.	„
Woodstock Kidney	W. K.	„

Late.

Ashtop Fluke	W. F. K.	med.
Bresee's Peerless.	W. F. R.	„
Brownell's Beauty	C. R.	„
Centennial	C. R.	st.
Edgcote Seedling	W. K.	med.
Eureka	W. K.	st.
Fluke	W. F. K.	med.
Grampian	C. R.	st.
International Kidney	W. K.	„
Lapstone	W. K.	med.
Late Rose	C. K.	„
Magnum Bonum	W. K.	st.
Model	W. F. R.	med.
Paterson's Regent	W. R.	st.
„ Victoria	W. R.	„

Late.

Prince Arthur	W. K.	st.
Red Skin Flourball	C. R.	„
Schoolmaster	W. R.	„
Scotch Blue	C. R.	„
Superior	C. K.	„
Trophy	C. F. K.	med.
York Regent	W. R.	st.
Yorkshire Hero	W. F. K.	med.

Abbreviations referring to shape, colour, and growth of haulm: W. white; C. coloured; F. flat; K. kidney; R. round; df. dwarf (less than 20 inches); med. medium (from 20 to 30 inches); st. strong (exceeding 30 inches).

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